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SCIENCE AND TECHNOLOGY

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EUROPE/LATIN AMERICA REPORT

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COLUMBUS PROJECT CHIEF ENGSTROM ON ESA GOALS, SWEDISH PART

Stockholm SVENSKA DAGBLADET in Swedish 4 Nov 86 Pt 3, p III

[Article by Karin Henriksson]

[Text] Paris--Europe wants to step into the next century.

These are big words, perhaps, but Fredrik Engstrom is speaking of a manned space station. It should be up by 1994.

Fredrik Engstrom left his position as executive vice president of Rymdbolaget 1 year ago and went over to ESA (European Space Agency) in Paris. There he is responsible for the employees, 150 so far, who are working on the Columbus Project--a station for research and production in space.

The 11 ESA nations, including Sweden, made the decision to go ahead with Columbus in January 1985. The next important date in the timetable will be in the spring of 1987, when data and costs for the program will be presented. Investments will total 25 billion kronor during the next 8 to 10 years.

New Products

Fredrik Engstrom did not hesitate a moment when asked if the Columbus space station would become a reality.

"Oh, yes."

"Europe is going ahead with this project in order to develop its industrial base--simply to see what new products and new technologies may be developed."

"In the past, Europe has conducted 6-day flights and attempted to cram everything into that amount of time. Now we are going to construct a station that will be manned permanently in space for perhaps 30 to 50 years. It will be used in precisely the same manner as a laboratory on earth. This has never been done before and, as a result, technicians and decision-makers must begin to form a new way of thinking."

Free Hand

At present, Fredrik Engstrom is in what he calls phase B, or that part of the creative process involved in a major process when everything moves from crisis to crisis. More specifically, the politicians want a totally free hand in the future, while the technical experts demand solutions as early as possible.

"I believe that zero-gravity industry will lead to unexpected discoveries and possibilities--although it is difficult to predict exactly what they will be," Fredrik Engstrom said.

"This has always been the case in the past when a new branch of natural science has been discovered. The Wright brothers' first flight was a modest beginning to the aviation industry of today."

Double

Europe decided to double its investment in space at the conference of ministers in January last year. Since that time even more funds have been allocated, according to Fredrik Engstrom. But even though Europe is a larger market than the United States, the European space program is only one fourth as large. What the United States--and for that matter the Soviet Union, as well--has that Europe does not yet have is the possibility of bringing things back from space. The planned space vehicle Hermes will solve this problem, its French backers hope.

France has been the leader in European space cooperation--partly because of its visionary approach and partly because it has placed a high priority on high tech investments. Most attention so far has been devoted to launchings. The French have made much progress in this area through the Ariane Program, said Fredrik Engstrom, who added that West Germany and Italy had shown great interest in a permanent space station.

Sweden, on the other hand, does not contribute as much money as it should, considering its gross national product, he continued.

"Belgium, the Netherlands, and Switzerland contribute percentages that are reasonable for them while Sweden, in comparison, provides only half as much."

"Eighty percent of the amount invested by countries is returned through industrial contracts, since ESA acts as a purchasing agent," Fredrik Engstrom said.

The Swedish companies mentioned in this connection include Volvo Flygmotor, Ericsson (telecommunications), and Saab (data processing).

The accident with the American space shuttle Challenger last year has had an impact on programs and our way of thinking about space.

"Safety has been given an even higher priority. The Challenger was an alarm clock--but we must be careful not to let the pendulum swing too far in the opposite direction," Fredrik Engstrom said.

9336
CSO: 3698/81

VOLVO 5-YEAR INVESTMENT 20 BILLION: NEW, FASTER TECHNOLOGY

Stockholm SVENSKA DAGBLADET in Swedish 20 Oct 86 Pt 3, p II

[Article by Sune Olofson]

[Text] Goteborg--Volvo has begun the most extensive period of investments in the history of the concern. Over a 5-year period, Volvo will invest at least 20 billion in technology modernization alone. The computerized automobile of the nineties will require the most advanced electronics in the world and the best engineers of Europe.

Investments for the 86-87 fiscal year will total 4 billion.

Volvo Personvagnar has employed 500 new specialized technicians during the past 3 years. Today over 3,000 employs are working on product development for future automobiles: 1,500 are working in the area of design and 1,500 are involved in process and production improvement. Seven hundred of the technicians are engineers.

Computer Center

The goal of Volvo's technological improvement program is to reduce the time required to manufacture an automobile by half by the beginning of the nineties.

The enormous Torslanda complex is now undergoing an extensive reconstruction process. The "Heart of Volvo," a secret technology center, is being restored and expanded at a cost of 300 million kronor. A computer center with an enormous capacity is being constructed in the area. The center will have over 300 terminals for advanced CAD/CAM design, simulations, and strength calculations. The few CAD/CAM centers that now exist in Sweden have a maximum of 50 terminals.

The technology center now has a prototype of a facility that will revolutionize spray painting operations at Volvo. It is a wholly automatic, robot-controlled spray painting box into which the automobile is carried by an automatic system. Within several years, the risky and environmentally dangerous paint work will not require contact by human hands.

Production Lasers

Volvo has also developed its own production lasers for the company's extensive welding work. The prototype cost 6.5 million.

The manned, so-called putty lines at the Torslanda plant have already been replaced with robot stations. Men and women who worked on assembly lines have now been retrained as robot technicians.

"The automobile industry is the most technology-demanding industry in the world. It can only be compared to the aerospace industry," Roger Holtback, executive vice president of Volvo Personvagnar, told SVENSKA DAGBLADET.

Work Harder

An American professor, Robert I. Cole, from the University of Michigan stated the following at an automobile seminar in Trollhattan:

"Volvo and Saab must work twice as hard to retain their shares of the market in the future."

Volvo's answer is to update its technology. Roger Holtback said the following:

"Volvo is meeting the challenge of the next generation of automobiles. In order to survive, we must develop our technical expertise. We must be able to reduce production times by 25 to 30 procent within the next few years. To do this, we must use technology to create a kind of Swedish model. Japanese manufacturers are more efficient today, but a Swedish worker would never be satisfied with the conditions found in Japanese automobile plants."

Northwesterly Direction

Volvo's automobile manufacturing is now moving in a "northwesterly direction," meaning that Volvo is concentrating on its more prestigious and sporty cars, such as the 760 and 480 series.

"To keep up in the automobile industry, we must look about 8 years into the future," said Dan Werbin, second vice president at Volvo Personvagnar and "prophet" at Volvo.

Werbin's job is to see the path, identify the goal, and form a basis on which investment decisions can be made.

"It is up to me to understand the mechanisms within the industry and get the entire gang, about 27,000 employees, moving in the right direction."

Dan Werbin said that Volvo had five goals for automobile production during the nineties:

Energy-efficient cars;

Safety/road handling;

Comfort/elegance;

Quality/reliability;

Long lifetime.

Werbin said that an automobile manufacturer must actually understand the society as a whole.

"You must be able to interpret how long a trend will last, for example."

Roger Holtback said that Volvo was not really interested in how much the technological renovation would cost.

Profits

"If we can just interpret the trends correctly and meet the customer's needs, the we will harvest the fruit in terms of profits. But the technological renovation requires enormous changes on the part of employees."

Dan Werbin said that Volvo would use computer electronics to increase safety.

"The driver of the future will see data of various types on the instrument panel. This data will represent communications between road and car and will also provide information on traffic jams, for example."

Suspension That Defies Natural Laws

Volvo is now working hard on a computer controlled suspension system. Three thousand times every second a computer in the trunk will record wheel movements and tell the suspension how to adapt itself to the road.

The system is called Computer Control Suspension (CCS). The electronic system works in such a way as to defy natural laws.

"We must now utilize electronics in automobiles if we are to improve safety and performance," executive vice president Roger Holtback of Volvo Personvagnar said.

Volvo automobiles may be equipped with CCS within several years. CCS is now being tested in a few 760 Turbos today.

CCS is called a "boat ride" system by Volvo researchers. The system is so fast that it reacts and compensates for its own movement at practically the same instant that the movement takes place.

Rises

In cars with ordinary suspension systems, the front end goes down when the brakes are applied strongly. The front end of a car equipped with CCS goes up, instead. Another effect of normal suspensions is that the car sways to the right during a left turn.

"A CCS car leans to the left, instead, into the curve," said Knut Leman, public relations director at Volvo Personvagnar. "CCS gives the driver a fantastic driving experience. It feels as if it is impossible to drive off the road."

CCS was developed by Volvo's dynamic safety research project, in conjunction with the formula 1 company Lotus. The system is a microprocessor controlled hydraulic suspension system.

Hydraulic Cylinders

The main computer in the trunk receives information from various transmitters located in the four hydraulic cylinders of the wheels, in the electronic speedometer, in the steering gear, and inside the car. The CCS computer can be programmed for the type of suspension desired, how much the car should sway to the side in turns, and the rigidity of shock absorption.

Instead of constructing various types of cars with different suspension systems, it is now possible to "change the chassis" on a car in less than 1 minute. A minicassette for a portable computer can provide 12 different chassis. The main computer can provide 66 different chassis properties.

Air Cushion System

An air cushion system providing increased safety for the driver will be available on the American market in 1987. Electronic systems are used here, as well.

In a collision, the cushion is inflated and covers the entire steering wheel to protect the driver.

The air cushion is built into the steering wheel hub and is combined with knee protection under the instrument panel. In a collision, the cushion is inflated by two small capsules that produce nitrogen gas. The cushion has a volume of 65 liters and is filled within 25 to 30 ms. A computer makes sure the air cushion is not inflated by anything other than a collision.

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SAAB-SCANIA STARTS NEW FACTORY IN NORWAY

Stockholm NY TEKNIK in Swedish 26 Oct 86 p 7

[Article by Christer Kallstrom]

[Text] Oslo--The new factory that Saab-Scania will construct in Norway will be located in the southeastern part of the country near the Swedish border. Cable systems will be manufactured at this facility. Establishment of the plant in Norway is the result of an order by the Norwegian military for 1,600 Saab-Scania trucks.

Saab-Scania will decide within the near future exactly where the plant will be located. It will probably be in Fredrikstad, Sarpsborg, or Skjeberg. They are all located within just 30 to 40 km of the Swedish border. The plant will be put into operation in early 1987. It will produce wiring systems (cable) for 1988 automobiles.

Upon completion, the new factory will employ 100 persons. Saab does not intend to construct a new building, but hopes to take over an old facility that can be reconstructed. Investments in the new plant will be between 7 and 9 million kronor. The facility needs a floor space of about 3,000 square meters.

Sharp Competition

Saab-Scania won the Norwegian order in sharp competition with manufacturers such as Volvo, MAN, and Daimler Benz.

The deal is worth 1 billion kronor and means that, between now and 1994, Saab will deliver 1,600 trucks to the Norwegian military. In return, Saab has promised to place orders for a corresponding amount, 1 billion kronor, with Norwegian companies.

The agreement includes a total of 30 Swedish-Norwegian joint projects in areas such as electronics, materials development, aircraft, robot, and space technology.

The first concrete result of the agreement is the new factory for the production of wiring systems in Norway. These wiring systems are the "nerve system" of

the modern automobile. As more and more advanced electronic equipment has been built into automobiles, the wiring systems have become one of the three most expensive components. A Saab 9000 contains 1,200 meters of cable.

Wiring systems are now manufactured in Kramfors, where 540 persons are employed. The new plant in Norway will have no effect on the Kramfors factory.

Many Norwegian companies are already producing automobile parts for Saab. Among the most important are Kongsberg Vapenfabrik, Raufoss Ammunisjonsfabrik, ASV, and Dyno Industrier. These companies now believe that the agreement on truck production will provide them with additional work.

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EUREKA CAR PROJECT PROMETHEUS BEGINS DEFINITION PHASE

Duesseldorf VDI NACHRICHTEN in German 17 Oct 86 p 2

[Article by Michael Pyper: "Prometheus, Or The Intelligent Automobile"]

[Text] Baden-Baden, Oct 17--In the next 8 years more than DM 1 billion is to find its way into the Eureka research project Prometheus. All the European car manufacturers are participating in the project, whose goal is the optimization of vehicle safety and traffic flow. The 1-year definition phase began on 1 October. The BMFT [Ministry for Research and Technology]will most probably assume the German portion of the costs, more than DM 14 million.

With the assistance of microelectronics, Prometheus' goal is to create an "intelligent" vehicle, in which electronically controlled functions guarantee maximum safety. The project is divided into Procar, which will investigate active safety in the car (such as ASR [acceleration skid control] and ABS [antilock brake system]), Procom, whose objective is communication between individual vehicles (for instance, a safe following distance) and Pronet, which is intended to create a supreme communications system (code word: guidance systems).

Five German automobile manufacturers, Audi, BMW, Daimler-Benz, Porsche and VW, are participating in the project. Ford and Opel, whose corporate headquarters are in the United States, will not take part in the project. It will require a financial involvement by the FRG of about DM 400 million. The first decision will be made by the end of November at the Minstry for Research and Development on subsidies for the definition phase. At the presentation of the project as part of the VDI [Association of German Engineers] congress on the topic of "Electronics in Motor Vehicles" in Baden-Baden on 9 and 10 October, Dr Heinrich Waldeyer announced that probably 40 percent of the total costs would be refunded to the 5 automobile manufacturers. The 4 scientific research institutes which were also involved would receive a 100-percent subsidy.

Waldeyer took this opportunity to explain once more the government's basic philosophy for lending support: "We will support those types of projects which are investigating innovative concepts, concepts which cannot be completed by private industry alone because of their long-term nature or their high

risk factor, or in which it is a matter of supporting the research side of public assigments which the state, the Laender and individual communities must take advantage of." The objectives of Prometheus would have a broad impact on the responsibility of the state with respect to its protective role, for example, in traffic safety, in environmental protection and in infrastructures for traffic and communications.

The director of research for VW, Prof Ulrich Seiffert sees a push for innovation for the automobile coming through microelectronics. He said that it was certainly "high time" to create an automobile-specific data buss to organize the flow of data, but the engineer rejected the "recommendations" from Japanese auto manufacturers to their European competition to pay more attention to electronics in the automobile: "Practically all the important developments in this area, such as the Lambda sonde, the three-way catalytic converter, antilock brake systems or fuel injection systems come from European auto manufactuters."

"Prometheus," Seiffert continued, "is intended to reveal the limits of what is possible." He said that partial solutions had already been implemented, and, based on the participation of the European governments, he is hoping that the necessary legal regulatory framework can be drawn up quickly.

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WEST EUROPE/AUTOMOBILE INDUSTRY

EURAM: ADVANCED MATERIALS FOR AUTOMOBILE

Duesseldorf VDI NACHRICHTEN in German 17 Oct 86 p 59

[Text] Brusssels, 17 Oct--The intent of the European research program for modern materials, Euram, is to bring Europe to the point where it is no longer lagging behind in this field and is independent of imports and licenses. The three areas of importance are: light alloys, ceramic materials and laminate materials.

The 4-year program, which has received DM 60 million from the EEC--the companies and institutes involved are contributing the same amount--is intended to help industries that rely on ultramodern materials: electronics, computer technology, telecommunications technology, the automobile industry, aviation and biomedical technology. Euram stands for "European Research on Advanced Materials." Its objective is to build manufacturing capacity in Europe for the needed materials in order to become more independent.

The materials involved are those such as magnetic iron-neodyme-boron alloys. The plan is to manufacture permanent magnets from these alloys, to replace electromagnets in many applications. The raw materials are readily available and inexpensive. The commission for the European communities forecasts that the new magnets will soon be found in automobile components such as starters, alternators and wiper motors. A further application could be in a medical recording technology that is based on magnetic nuclear resonance.

Ceramic materials for future generations of combustion engines could make an adiabatic engine, that is, one that does not pass heat, possible. It could run at a constant temperature of 1,500°C, it would not require cooling and it would be 30 to 40 percent more efficient.

Laminated materials, which are already used in a very wide range of applications--from the artificial hip joint to construction material--will have a new assignment in automobile construction: drive shafts made of CRP [carbon fiber reinforced plastic].

Euram research is heavily interdisciplinary, and as a result, each country can contribute with its special strengths, as the speaker of the central executive committee for research, science and development in Brussels, Dr E. Bock, stressed. It was equally necessary to generate unified European standards for these high technologies.

"The function of the Euram money should be that of giving a stimulating shot in the arm. We do not want to use a watering can, that would only create laziness or a lack of ideas," was Dr Bock's explanation of the 50-percent clause. Otherwise the participants would just "lick their fingers."

9581
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STATUS OF ESPRIT OPEN SYSTEMS ARCHITECTURE

Paris ELECTRONIQUE ACTUALITES in French 3 Oct 86 pp 4

[Text] Having gotten off to a late start compared to America in the field of Computer Integrated Manufacturing (CIM), Europe is tackling the problem on a more conceptual level by attempting to define an open architecture. The Esprit CIM/OSA program, which involves a 19-member consortium headed by Cap Gemini Sogeti, has entered a specification phase with the idea of working on creating business and data models, as well as data processing technologies. While the CIM/OSA program embraces existing standards, it also has the additional goal of influencing standardization work in progress.

CIM/OSA (Open Systems Architecture), also called AMICE (European Computer Integrated Manufacturing Architecture) [as published], did not have a strong impact at the presentation given by Cap Gemini Sogeti at the Convention Informatique. This fact can be explained by the specialized nature of this convention, which was more oriented towards computer topics of interest to SICOB visitors, while Computer Integrated Manufacturing is a multidisciplinary field bringing together computer experts, production engineers, and decision makers. This situation may change in the future, since, as Cap Gemini Sogeti acknowledges, the CIM market is probably the one that will offer the greatest possibilities for growth in the next few years. And since it is a matter of integrating existing or future computer systems, the rules have to be defined.

Existing Standards To Be Included

America has already tackled the CIM problem, mainly through General Motors' MAP (Manufacturing Protocol) initiative. Rather than taking the pragmatic approach, which aims at developing a communications standard, the Europeans have preferred to approach the problem by defining a CIM system structure and developing a model. This is the goal of the Esprit CIM/OSA program. It should be recalled that the project involves a 19-member consortium with Cap Gemini Sogeti as prime contractor (AEG Telefunken, Aerospatiale, AT-T and Philips, British Aerospace, Bull, CGE, CRI, Dornier, GEC, IBM, Italsiel, Philips and MBLE, Seienia-Autotrol, Siemens, and Aixla-Chapelle university, plus Volkswagen, Digital Equipment and ICL, which joined OSA after it was already underway). This program represents a total of 14 million ECU's and calls for 250 man-years. The current contract covers 114 man-years.

The OSA program began in 1984 and will end in 1988. This is the Esprit I phase, and there is much talk of an Esprit II phase. Since the ultimate goal is not to impose standards but to provide a model, OSA is taking existing standards such as MAP and OSI into account. However, OSA will take part in standardization work through participants in various organizations. In addition, the service companies and manufacturers involved in this program will profit with respect to future computer developments, since OSA is to define an architecture that will be useable over a long period of time.

After the specification phase, which is scheduled to end in late January 1987, the OSA project will be decentralized, probably into three areas: creating a business model, creating a data model, and data processing technologies. This last topic will deal with communications, data storage, and data management, data processing, and applications management. The work will also involve interfacing to both the production machines and the human operator.

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HIGH-SPEED STEEL-CUTTING, WELDING LASER AT SCIAKY OF FRANCE

Paris INDUSTRIES & TECHNIQUES in French 20 Sep 86 pp 43

[Text] Already one of the world leaders in electron beams, Sciaky is making a strong showing in thin-sheet laser welding. With the major problems connected with high power practically all resolved, this technique is coming to occupy an important place in the precision welding of mass manufacture parts. Foreseeing this development, Sciaky aimed for what is currently the highest power level in Europe. Its 8 kW laser at its Vitry-sur-Seine shops welds a 10 to 12 mm thickness of stainless steel at a speed of 30 to 50 cm per minute. It cuts 20 mm carbon steel at a speed of 1.5 m per minute, and 10 cm titanium alloy at a speed of 2 m per minute. This laser is essentially a laboratory tool for the research and development of applications and hardware linked to specific characteristics of high-power beams. It was installed with the help of ANVAR, DIMME, and MST, and was designed in close cooperation with the vendor. Sciaky's experienced specialists designed the additional equipment and the laboratory portion.

Continuous Laser Effect Produced from a CO2 He N2 Gas Mixture

The laser station is also available to potential users for feasibility testing as well as for studying the technological developments that using lasers in future installations will require, e.g., defining welding heads, testing afocal optics without the annular vacuum, running behavior tests on beam distribution optics, etc.

The laser source is in a separate location from the work and research stations. The continuous laser effect is produced from a CO2 He N2 gas mixture. Mirror focusing is performed by transmission and concentration optics adapted to the various applications. This generator, with its transverse gas circulation, water cooling, resonating optical cavity, and control cabinets, occupies 15 m2 floor space. A microcomputer performs control and management functions. The annular beam has an exterior diameter of 70 mm, an interior diameter of 35 mm, a 10.6 micrometer wave length, and 5 percent stability over an 8-hour time period.

The work station for welding, cutting, and thermal processing applications is equipped with a F7 focusing system that uses a 400 x 600 mm table and a revolving system to produce interpolated trajectories. A Z axis may be made

available. This station's flexibility means that it can be adapted to any research and development structure. It can also be fitted out to work on stationary pieces with mobile optics.

PHOTO CAPTION

The annular beam (exterior diameter: 70 mm; interior diameter: 35 mm) features a 10.6 micrometer wave length and 5 percent stability over an 8-hour time period. (Sciaky Doc.)

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SWEDEN WORKS WITH JAPAN IN DIRECT CASTING R&D, PRODUCTION

Stockholm NY TEKNIK in Swedish 30 Oct 86 p 41

[Article by Carl Daniel Norenberg]

[Text] Direct casting of metal wire could replace cold drawing for diameters of about 0.1 mm, according to Associate Professor Lars Arnberg and Professor Rune Lagneborg of the Institute of Metal Research in Stockholm. In addition to providing new mechanical and electrical properties in wire, the method that is being developed in cooperation with Japanese researchers will also provide a more efficient process with regard to the energy required in production.

One of the greatest advantages of the new method is that it is possible to go directly from melt to finished wire.

At present, wire drawing plants prepare an ingot, which is then rolled or "drawn" in several stages to its finished dimensions. The wire substance is often heat-treated repeatedly.

This, in turn, limits the selection of alloys and the ultimate properties of the wire. The process is also costly and requires much energy.

High Cooling Rate

In the new method, the melt is pressed out through a nozzle, down into a rapidly rotating cooling medium. By allowing the coolant to flow past the wire material, it is possible to avoid the formation of an insulating steam layer that would prevent maximum heat exchange. Using ordinary water, it is now possible to achieve cooling rates of almost 1 million degrees per second.

"The high cooling rate makes it possible for us to produce wires with unique properties," Lars Arnberg said.

New Alloys

"Of particular interest are alloys and so-called supersaturated solid solutions that cannot be produced in any other way than as a finished product," Lars Arnberg said.

Examples include steel alloys with up to 5 percent carbon contents. After just a light follow-up drawing, wire of this kind has greater strength and better corrosion properties than piano wire, for example.

In addition, the high rate of cooling means that it is possible to avoid the states of equilibrium that normally occur during cooling. The grain sizes of these so-called microcrystalline alloys is extremely small. As a result, alloying materials that would normally separate out can be added.

Sensor Materials

In extreme cases the atoms do not form crystals, but so-called metallic glass.

The advantage of metallic glass alloys is that they have unique electromagnetic properties.

"A metallic glass wire responds magnetically very rapidly to an electrical pulse and, as a result, it makes an outstanding sensor material in electronic circuits," Lars Arnberg said. The material also has extremely low magnetic reversal losses.

It is already being used to produce transformer plates by rapid solidification techniques. Other applications include electric motors and electromagnets. By weaving a net of conducting wire and magnetic wire, it is possible to create components with new electromagnetic properties.

Japanese Method

"Our laboratory equipment, like the original method, comes from Japan where it is already in commercial use," Prof Rune Lagneborg said. In Sweden the project is being conducted under the "Quick Setting Alloys" project of STU (Board for Technical Development), with ASEA and Sandvik as the main interested parties.

9336
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SWEDISH FLAKT TO DEVELOP CLEAN ROOMS FOR SIEMENS, PHILIPS

Stockholm NY TEKNIK in Swedish 16 Oct 86 p 38

[Article by Anne Laquist]

[Text] In a totally new facility in Munich, West Germany, Siemens and Philips will meet the competition from Japan and America in the field of electronics. New superchips will be developed in two gigantic clean rooms, where it is cleaner than in outer space.

The Swedish firm Flakt has offered to sell clean room technology for 50 million kronor to the German developmental laboratory. Flakt is also involved in several other major clean room projects. Producing clean rooms has become big business.

For 2 years now Flakt, the largest European company in the areas of ventilation and working environment, has been attempting to elbow its way in among the giants in clean room technology. During this time the company has invested 8 million kronor as development money in the area of clean rooms. The money was invested in Sweden.

In reality, much more capital is involved. Flakt is working together with Japan's largest clean room company, Takasago, through a jointly owned firm, Flakt Nippon.

The development of clean room technology is extremely expensive. Only the truly large companies can afford to invest the required amounts of money.

The investments will continue, according to Flakt. The company has begun to produce special clean room modules. At Flakt's climate control center in Nacka, workers are building a developmental laboratory for clean room technology.

The European clean room market is hot. Sales of about 1 billion kronor are expected to increase by about 15 percent annually.

Flakt, whose clean room sales this year will total 50 million kronor, has even higher ambitions. It hopes to increase its figure to between 75 and 100 million next year.

Of course, it is the explosive developments in electronics that are responsible for this. More and more extreme cleanliness is required as chips become smaller and smaller and more and more functions are packed together on them.

In the stiff competition that prevails in the world of electronics, manufacturers in Europe have found their own niche: electronics that are tailor-made for the customer. The Japanese and American firms must now compete harder in order not to lose ground on the European market. IBM, Digital Equipment, and other electronics giants are planning major projects in Europe to counter the European tailor-made electronics production. These are projects on the order of 2 billion kronor, in which clean rooms will cost about one tenth of the total amount.

Secret

This clean room construction is extremely hush-hush. By indicating the clean room category of a project, a company gives away its level of technological development to the competition.

Flakt is now negotiating with an American firm that is planning to construct a facility in Spain for the production of megachips. "Clean room class 1" gives away the fact that the company is involved in superchips of the future with a memory capacity of 4 Mbits.

Several projects are now under way in Europe.

In Paris Flakt is building a clean room of 180 square meters for optical technology with various purity categories for Digipress Client, which makes optical lasers for compact discs.

Flakt produced clean room technology for a simulator room that is 11 meters high at IAL Space Research Center in Liege.

The Siemens facility in Munich received ceiling systems, filters, and air conditioners for two gigantic clean rooms of 2,200 square meters each from Flakt, which also provided the control instruments. The requirements were high: purity class 10.

A scanner with laser particle meters was used to check the air-tightness of the ceiling. One fifth of the ceiling filters had to be replaced.

"The manufacturer simply did not measure up," said Bertil Larsson, project leader for Flakt Inomhusklimat.

Several large European companies, including the Swedish company Saab through Saab Combitech, are working together on the so-called ES 2 Project (European Silicon Structures), the purpose of which is to manufacture tailor-made chips with a high packing density: in the megaclass. A class 1 clean room of 1,500 square meters will be built in France. Flakt is also competing for this job.

In an attempt to outmaneuver the competition, Flakt is now producing turnkey clean rooms. The company is among the few in Europe that have a complete program for turnkey clean rooms. The American company Shugart of Munich has purchased on of them. This company repairs hard discs, which are small, hard memory discs with an extremely high storage capacity.

"Clean room technology today means total solutions," Bertil Larsson said.

Purity demands within the electronics industry are so high that modern ventilation and filter techniques for producing a clean environment are insufficient. The entire industrial process inside the clean room is involved in the hunt for microscopic particles, which must be eliminated.

Some of the factors involved are the work routines used in the clean room, the type and placement of machines used there, clothing, personnel training, control and measuring instruments, and service.

This involves broad technical know-how that is difficult to find today. Expertise in Sweden on clean room technology is still rather shallow and widely scattered. Where the need for a clean environment has arisen, the problem has been solved locally at its point of origin.

"The greatest dilemma is that customers find it difficult to specify their own requirements," said Bertil Larsson of Flakt.

"We cannot afford any mistakes. The entire effort is wasted if the clean room technology does not work satisfactorily."

The thinner the chips, the more sensitive they are. If there is a single small particle in the way, the chip loses its ability to conduct. A 70-percent waste rate and 30-percent yield is not uncommon in the semiconductor industry.

Enormous Losses

This high waste rate means enormous losses. An American manufacturer of 256 kbit RAM memories (primary memory within the computer) estimates that it would be possible to save millions within a few weeks if the yield could be increased by only 1 percent. The company is now forced to throw away 80 percent of what it produces.

The planned microwave institute in Kista may become Flakts largest overall project to date if the company gets any nibbles on the lines it has thrown out. The project will involve a clean room of 1,300 square meters in purity classes from 10,000 down to 100.

An electronics project in Yugoslavia will include a class 10 clean room of 5,000 square meters. Several companies will work together toward the total solution. Flakt is involved in the negotiations.

Through its Finnish company, Flakt is also involved in several projects in the Soviet Union for pharmaceutical production and electronics.

9336
CSO: 3698/81

AUSTRIAN FIRM DEVELOPS ION BEAM LITHOGRAPHY CHIP METHOD

Vienna PROFIL in German 24 Nov 86 pp 40, 42

[Article by Stefan M. Gergely: "Across the Threshold with Semiconductors: A Viennese Firm Is for the First Time Able to Produce Circuits on Semiconductors That Are a Hundred Times More Densely Packed Than Those Commercially Available Today"]

[Text] The technology is called ion beam lithography. It is used for the purpose of producing semiconductor units that hold a hundred times more data than conventional chips. Using them, it will be possible in the next 10 years to build easily manageable computers with performance characteristics that are unimaginable today.

The birthplace of the new technology is neither California's Silicon Valley nor a high-tech lab in Japan, but rather the address Schreygasse 3 in the Leopoldstadt section of Vienna. There, the 26 technicians of the IMS (Ionen Mikrofabrikations Systeme GmbH) company, which has been in existence for some 19 months, are preparing for the age of sub-microelectronics. Because of this, Austria for the first time has a real opportunity to soon be in the forefront of this strategic branch of information technology. Because there is no doubt that the miniaturization of electronics will be making further giant leaps:

--The most highly integrated commercially available chips--they are known as 256 K chips and hold the contents of approximately 20 typed pages--are still "formed" using light: The circuitry of transistors and electric resistors is mapped by light beams on the surface of silicon chips, which illuminates a film-like layer, similar to photography; the illuminated sections are then etched chemically, whereby the circuitry paths are plotted; using this technology, known as photolithography, they are several micrometers (thus several thousandths of a millimeter) thick.

--The one megabyte chips, which are packed four times more densely and have just now become available on the market, cross the one micrometer threshold. Their dimension approximates that of the wavelength of visible light. According to the laws of physics, however, electromagnetic beams cannot project the image of objects that are smaller than their wavelength.

--It is probable that the 64 megabyte chip will be on the market by the mid-1990s at the latest. Their circuitry paths will be thinner than 0.2 micrometers. Photolithography cannot produce this type of microstructure, but the technology developed by IMS can. It employs ions (electrically charged atoms). These ions are accelerated through electrical fields, pass through the gaps in a metal mask (the gaps correspond to the circuitry layout), are again accelerated and focused, and then rain down on the surface of the semiconductor; there, they cut a reduced facsimile of the circuitry. The physical limit of this process is less than 0.01 micrometers.

"The semiconductor industry," Fritz Paschke, professor of electronics at the Technical College of Vienna, is convinced, "will not be able to do without ion beam lithography." According to market researchers, the market for lithography machines should increase from $570 million in 1982 to just under $4 billion in 1990 and continue to multiply until the turn of the century. "By no later than the middle of the coming decade," according to calculations by physicist Gerhard Stengl, the manager of IMS and the spiritual father of the new technology, "we want to be selling between 50 and 100 ion beam machines." Cost per unit: two to three million dollars.

An ambitious plan, since only 2 years ago Stengl and his partner Hans Loeschner had only the idea for a machine, but no money with which to build it. If the Research Stimulation Fund for Trade and Industry had not at that time made five million schillings available for a pilot facility, it would have presumably remained at the idea stage.

"We wasted an incredible amount of time," Loeschner says, "in gaining project funding from Austrian firms." Even though the two technicians were greeted warmly, no one was financially responsive to the idea of ion beams, he says.

Only Professor Paschke was enthusiastic from the outset. With his help, Stengl and Loeschner finally came across Techno Venture Management (TVM) in Munich, a company that invests venture capital in innovative projects. TVM had renowned experts study the pilot facility in Leopoldstadt. These experts found the project to be without promise, and advised that no money be invested in it.

TVM finance manager Franz R. Krejs invested anyway. A total of 22 million was ultimately made available by TVM, CA-3-Banken-Venturefonds AG, entrepreneur Rudolf Fries and the Viennese firm Horizonte Venture Management GmbH; since then, IMS has had a 54 percent share (the rest is in the hands of the company employees). Another 10 million was added by the Ministry for Transport and Nationalized Industries from the resources for public-sector support of microelectronics.

Through this, Stengl and Loeschner had enough money to finally prove that ion beams can in fact be used to produce maximum integrated circuits. In the meantime, IMS has even become involved in "Eureka," the ambitious European high-tech research project (project scale: approximately 50 million schillings). And IMS also recently received the first two orders to build ion beam machines for research purposes.

In the meantime, international experts have begun to take notice of the Austrian high-tech company: representatives of semiconductor companies with sales in the billions have come knocking on IMS's door. An international consortium for venture capital will be investing an additional 100 to 150 million schillings this year.

In no way does this mean that the race has been won. Over the next 2 years, the big semiconductor firms will be developing pilot facilities to determine how 4 megabyte chips, and then 16 and 64 megabyte chips, can be produced in gigantic quantities. Because the submicroscopic mapping of circuits on silicon chip surfaces using ion beams is only one component of chip production, albeit a very important one. Only after the IMS technology has proven to be viable for industrial production will economic success be a tangible reality for the Viennese high-tech firm.

"The time factor," says Stengl, mentioning another hurdle, "is a dramatically dominant element": as a rule, the winner on the chip market is whoever has created the basis for industrial competition to the next stage of integration. It is not unusual for intervals of a few months to make the difference between winning and losing. Austrian bureaucracy has for the time being proven to a high-tech spoiler in this competition:

--The transfer of foreign venture capital to Austria generally takes several months. According to Franz R. Krejs, who now manages IMS's venture capital, the Austrian National Bank is to blame for this: state-imposed conditions have meant that capital, the most essential characteristic of which should be its rapid availability, is in practice frozen.

--State support also takes place too slowly in Austria: the period between the--in principle gratifying--pledge for a 10 million schilling subsidy from the Ministry for Transport and Nationalized Industries and its actual payment amounted to 6 months. Krejs: "Money has temporal value"; a delay of only a few months could cast doubts on the success of a project.

--IMS physicist Stengl feels that ultimately a "consciousness for high-tech projects oriented towards the world market" is missing in this country. Austrian investors have regularly asked whether the ion beam technology has already been developed in the United States or in Japan; on hearing that it has not, the general opinion has been that this technology is then useless, he says.

There are in fact good reasons why the foreign competition has not mastered the IMS technology: special tricks, naturally kept secret by IMS, are necessary in order to generate a sufficient quantity of ions and to accurately refract them such that they cast the sharply reduced image of a mask on the chip surface with the highest degree of precision. Thus far, no one other than the IMS technicians has succeeded in implementing this process. But it works. "If the project were to flop," Professor Paschke says, "I would feel really stupid."

12271
CSO: 8120/3347

FRG'S TELEFUNKEN BUILDS MOCVD DEVICE FOR GALLIUM ARSENIDE IC'S

Karlsruhe BMFT FORSCHUNGSBERICHT T 85-038: BASISTECHNOLOGIE FUER MONOLOTHISCH INTEGRIERTE GaAs KOMPONENTEN in German Apr 85 pp 6-32, 87

[Research report by Drs. Alexander Colquhoun, Werner Mroczek, and Jochen Gerner of Telefunken Electronic GmbH in Heilbronn, West Germany]

[Excerpts] 1 Introduction

This report describes basic technologies that are used for making integrated circuits on gallium arsenide substrates. At the same time, the preparation of the material with an eye to an integration for extremely high frequencies was intensively treated, in order to be able to assess, for instance, special features of structures (for example, dual-gate MESFET's) on epitactically prepared layers in comparison to implanted structures. Whereas in general epitactically prepared material shows better electric properties, the advantages of implantation technology lie in its greater flexibility and in the possibility of producing completely planar structures.

Chapter 1 (Epitaxy) treats epitaxy procedures, above all the methods of metallo-organic epitaxy. As a comparison with this, implantation technology in semi-insulating material was investigated (Chapter 2). The following chapters then concern themselves with the elaboration of processes for certain components and with the interpretation of the electrical measurements.

2.2 Design of the Epitaxy Unit

The MOCVD unit was designed at the start for flexibility in development work (several different sources, two chemical reactors for alternate operation).

In order to be able to make use of as large a substrate surface as possible, instead of the frequently used high-frequency heating a radiant heating system was chosen. With that, water cooling of the reactor tube was excluded, so that air cooling had to be used. The coolant air is blown in between the quartz reactor tube and an outer tube, which likewise consists of quartz.

The reactor tube and the gas-line network can be evacuated, in order to permit leak-tightness tests and to be able to degas the graphite portions prior to the process. The gas-line network was designed in such a way that it is easy to expand the system to include GaAlAs growth. Corresponding valves were provided for an aluminum-MO compound and for other liquid sources.

The controlling of the system is performed by a process computer. All the functions of the MOCVD unit are automatically controlled, so that after charging the reactor tube an epitaxy process is executed completely automatically.

A schematic diagram of the gas system can be seen in Figure 2.1. Two reactor tubes are supplied from one gas system; the reactors can be operated interchangeably. All important gas volumes are regulated with "mass flow controllers." The gas system is designed in such a way that three separate lines with their own H_2/N_2 flushing-gas connection in each case are run up to the reactor inlet. Connected to these three lines are:

1. AsH_3, H_2S
2. DEZ (or other liquid sources)
3. TMG, TMAl, HCl

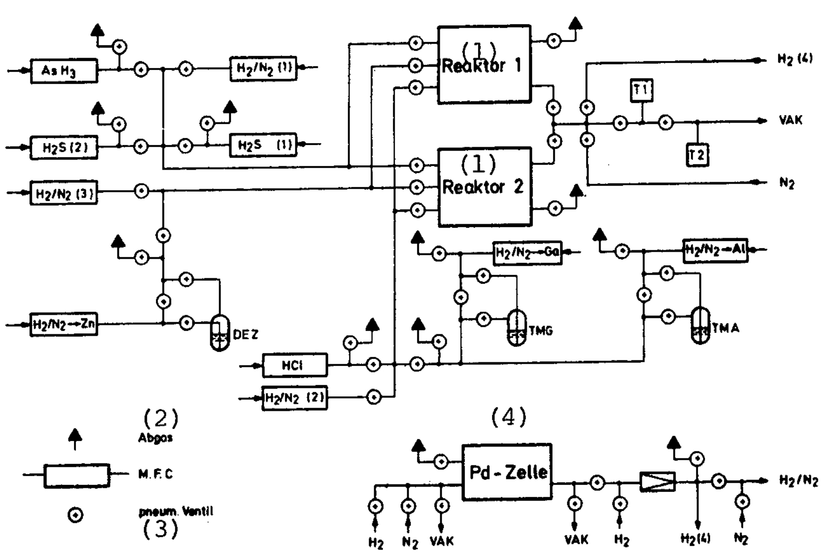

Figure 2.1 Schematic Diagram of the Gas System of the MOCVD Unit

Key:
1. Reactor
2. Waste gas
3. Pneumatic valve
4. Pd cell

The HCl is employed after each epitaxy process for cleaning the reactor tube, and it can also be used for an "in-situ" etching of the substrates.

The DEZ source is equipped with a separate line in order to prevent introducing any impurities in the other lines. AsH_3 is kept separate from TMG in order to permit, for example, a pre-decomposition of AsH_3.

2.3 Reactor Geometry

A reactor cross section in the longitudinal direction is shown schematically in Figure 2.2. The AsH_3 and TMG lines have a common inlet into the reactor tube. Separate inlets were also tested, but no advantages could be ascertained by doing this. The inflowing gases are mixed together by a manifold. In the separation tube the by-products of the process are collected, so that after each process they can be removed easily. Since the optimal growth conditions are always with an excess of arsenic, the by-products essentially consist of arsenic. The intermediate space between the separation tube and the main tube is flushed with hydrogen during the process, in order to prevent separation in this area.

At first the main tube was designed with a round cross section so that it could be evacuated. Initial tests with a simple graphite substrate holder (Figure 2.3 (a)) led relatively rapidly to layers with a good surface morphology, but with a very uneven deposition over the wafer. The cause of this was essentially the convection of the gases. The flow of the gases was changed in different ways in order to achieve a more uniform deposition. This can be done, for example, by narrowing the quartz tube with quartz screens (Figure 2.3 (b)) or by increasing the gas velocity. In this manner the fluctuations in thickness could be reduced, but the variation along the wafer was still too large (> 30 percent) to thereby produce integrated circuits with MESFET'S. The cross section of the tube was too large, and the wall cooling failed along the built-in screens, which led eventually to deposition on these parts.

In order to solve this problem, evacuation was dispensed with and a tube of rectangular cross section was used having about half the cross-sectional area of the round tube (Figure 2.3 (c)). The cross section was reduced even further by using thicker graphite portions (Figure 2.3 (d)), and this led to the best growth conditions. With this configuration and a gas flow rate of about 20 cm/sec. over the substrates, satisfactory and reproducible results could be achieved that were in line with the literature /1/.

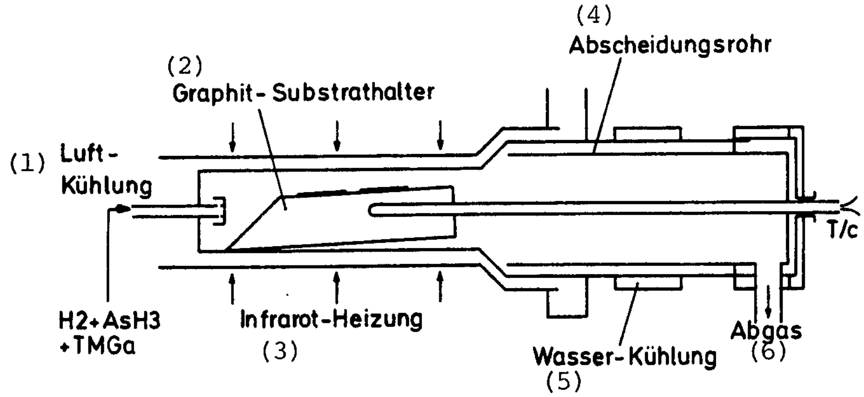

Figure 2.2 Schematic Diagram of the Reactor Tube--Cross Section in the Longitudinal Direction

Key:
1. Air cooling
2. Graphite substrate holder
3. Infrared heating
4. Separation tube
5. Water cooling
6. Waste gas

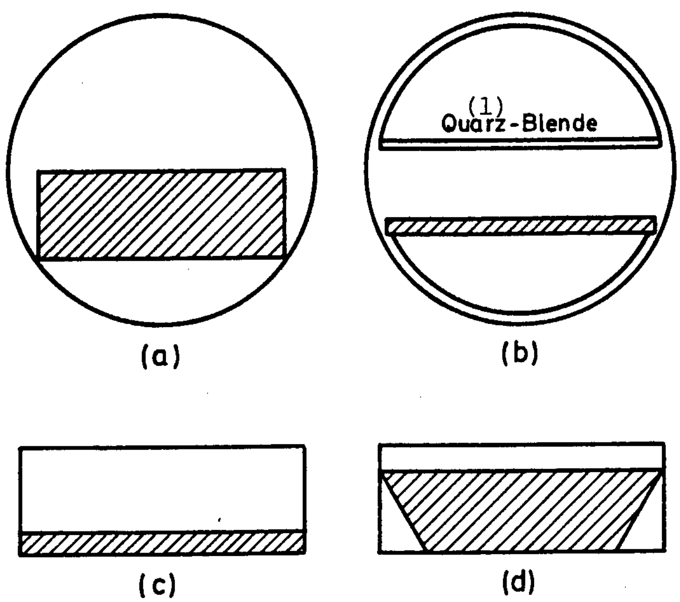

Figure 2.3 Various Reactor Configurations

Key: 1. Quartz screen

2.4 Uniformity of the Deposition

The influence of the graphite substrate-holder geometry can be seen in Table 2.1. From boat E5 on, the reactor configuration is always that of Figure 2.3 (d), with an inclination of the boat in the longitudinal direction.

Table 2.1 Graphite Boat Changes, MO Epitaxy

Boat	Thickness mm)	Length (mm)	Description
E1	45	145	For 1 wafer - round tube.
E2	5	350	Suspended in the quartz rack with quartz screens for gas flow control - round tube - screw attachment for the wafers
E3	10	220	For rectangular tube - screw attachment.
E4	5	180	Like E3, but beveled in front and on the side in order to reduce wall contact surface
E5	25	200	Beveled 45° in front, screw attachment - angle of deposition surface adjustable.
E6	25	200	Like E5, but wafers in recesses - for 2 wafers.
E7	30	200	Like E5, but 30 mm thick.
E8	25	280	Like s E5, but for 3 wafers - angle in front 26°.
E9	25	295	Like s E5, but for 4 wafers - angle in front 45°.

The inclination angle was optimally adjusted by a series of epitaxy processes. Figure 2.4 shows the influence of the inclination angle on the distribution of layer thickness and the growth rate. Boat E7 is 5 mm thicker than boat E6 and leads to substantially higher rates of growth. With boat E7 and at inclination angles larger than 1.5°, one observes increasing deposition on the quartz tube directly above the substrates. Boat E6, with an angle of inclination of 1.5°, gave the hitherto best uniformity. Figure 2.5 shows the fluctuations in thickness above the two substrate wafers of boat E5. Position 2 gives a very uniform deposition, with a minimum thickness in the center. In general, a U-shaped growth can be seen.

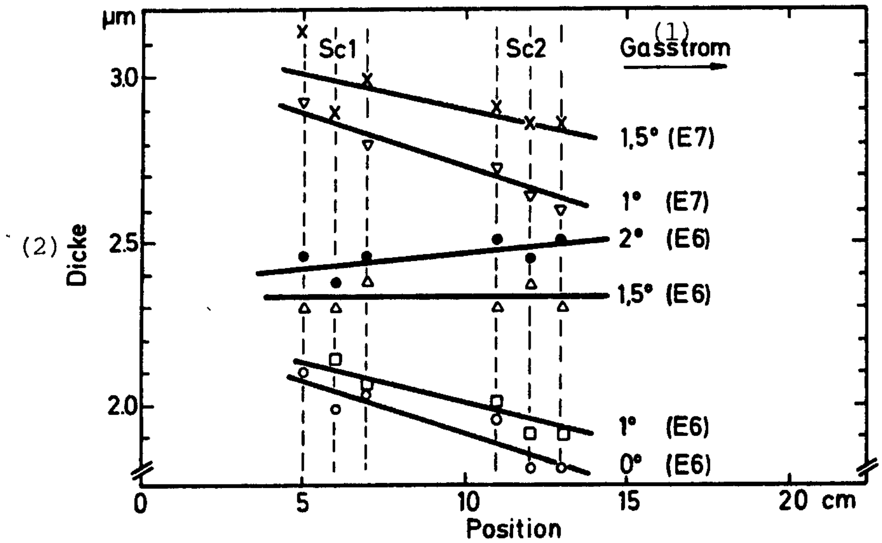

Figure 2.4 Uniformity of Deposition in the Longitudinal Direction as a Function of the Inclination Angle (two-cup boats); Temperature and Flow Volumes Constant

Key:
1. Gas flow
2. Thickness

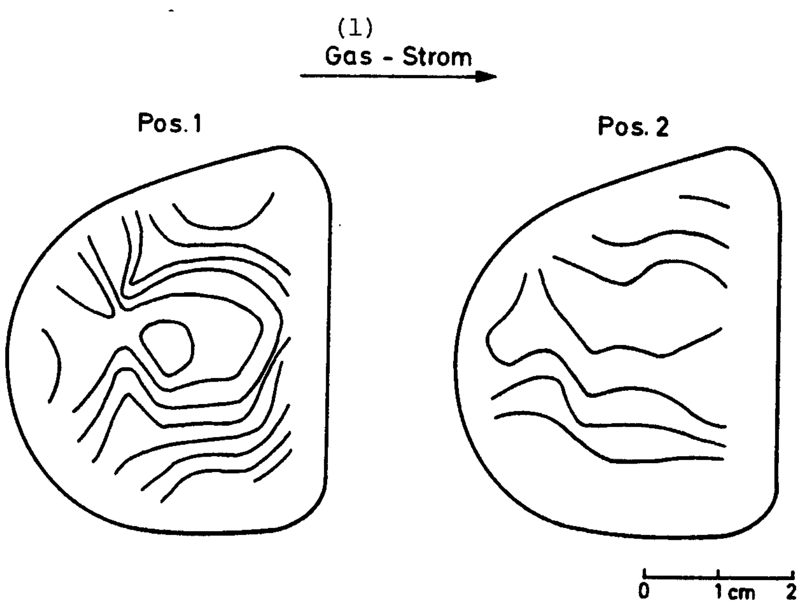

Figure 2.5 Contour Diagram of the Deposition (two-cup boat (E6))
Thickness: Pos. 1 2.85 μm in the center
Pos. 2 2.9 μm in the center
Lines: 0.05 μm separation in each case

Key: 1. Gas flow

The results from boat E8 with three wafers are shown in Figure 2.6. Here the U-shaped growth is more pronounced, and the growth rate has become distinctly smaller.

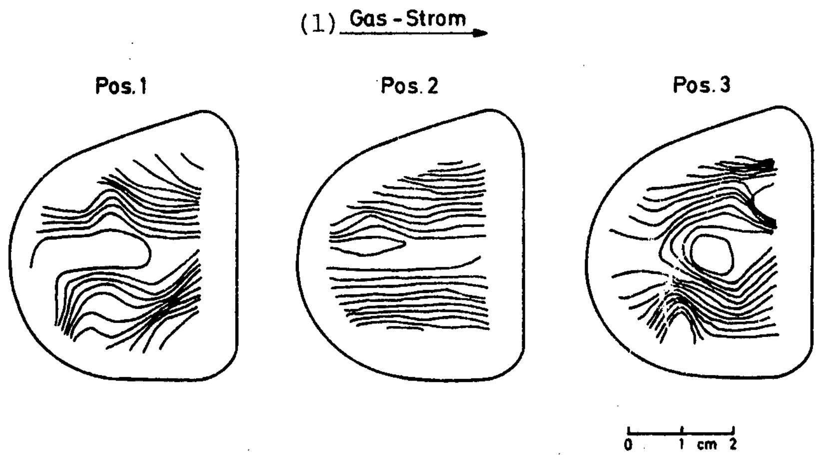

Figure 2.6 Contour Diagram of the Deposition (three-cup boat (E8))

Thickness: Pos. 1 2.38 µm in the center
Pos. 2 2.37 µm in the center
Pos. 3 2.02 m in the center

Lines: 0.05 µm separation in each case

Key: 1. Gas flow

The other investigations of the electric properties of the layers were carried out mostly with boat E6, position 2.

2.5 Growth Rate

The growth rate of the layers is highly dependent on the geometry of the reactor and substrate holder. But with the same geometry, the growth rate at the same location can be reproduced well and can be adequately controlled. At growth temperatures above a certain threshold /2/, the growth rate is dependent essentially only on the TMG partial pressure and thus on the flow rate of the TMG-carrier gas.

Figure 2.7 shows the growth rate as a function of the TMG flow rate. Over a very wide range, it is largely a linear function of the flow rate.

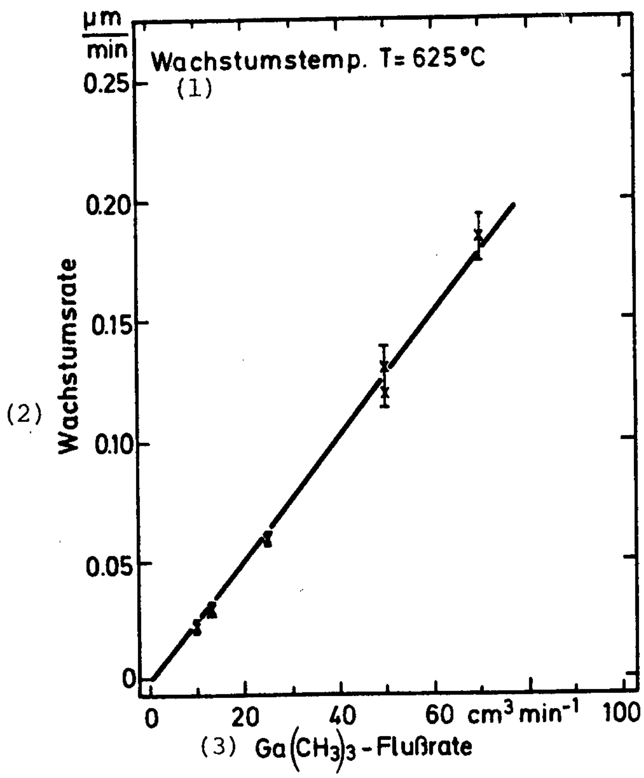

Figure 2.7 Growth Rate as a Function of the $Ga(CH_3)_3$-Carrier Gas Flow Rate. $Ga(CH_3)_3$ Held at 0° C.

Key:
1. Growth temperature
2. Growth rate
3. $Ga(CH_3)_3$ flow rate

The surface morphology of the epitaxy layers is practically structureless between [As]/[Ga] = 3 and 100. With [As]/[Ga] $\leq$ 1.5, a slight cellular structure can be seen (see Figure 2.10).

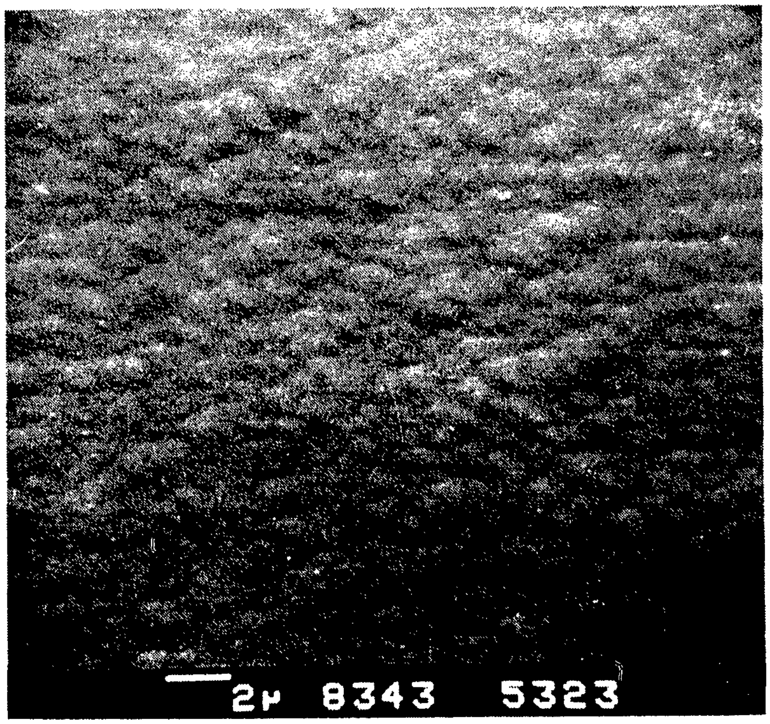

Figure 2.10 Surface Morphology of an Epitaxy Layer Grown with [As]/[Ga] = 1.5

2.6.5 Photoluminescence Measurements

To assess material quality and to identify impurities, photoluminescence measurements were carried out on the material grown by means of MOCVD. (Footnote) (The measurements were performed by Dr Dave Kisker at the Max Planck Institute for Solid-state Research, Stuttgart)

The 514-nm line of an Ar laser was used to excite luminescence; the power of about 50 mW was concentrated on a surface of about 2 mm diameter. The samples were held to a temperature of 4.2 K by means of liquid He. Suitable filters were employed to exclude laser light, flat luminescence, and lines of a higher order. Either a Ge diode or a PbS photoresistance cell was used as a detector.

A typical photoluminescence spectrum of a MOCVD layer on n+ material is shown in Figure 2.18. In addition to the near-band emission, two broad maxima at 0.95 and 1.15 eV are seen. These two maxima occurred with all samples on n+ substrates. The maximum at 1.15 eV is characteristic of the substrate material used here and is possibly a manifestation of the substrate. We have also detected the maximum at around 0.95 eV with MOCVD material from another manufacturer. It is probably characteristic of the MOCVD material. But material prepared under identical conditions on Cr-

doped substrates do not show this maximum. A possible explanation of this is that recombination in the grown layer brought about by Cr is much more pronounced than recombination over the 0.95 eV level, and that therefore the latter is no longer detectable.

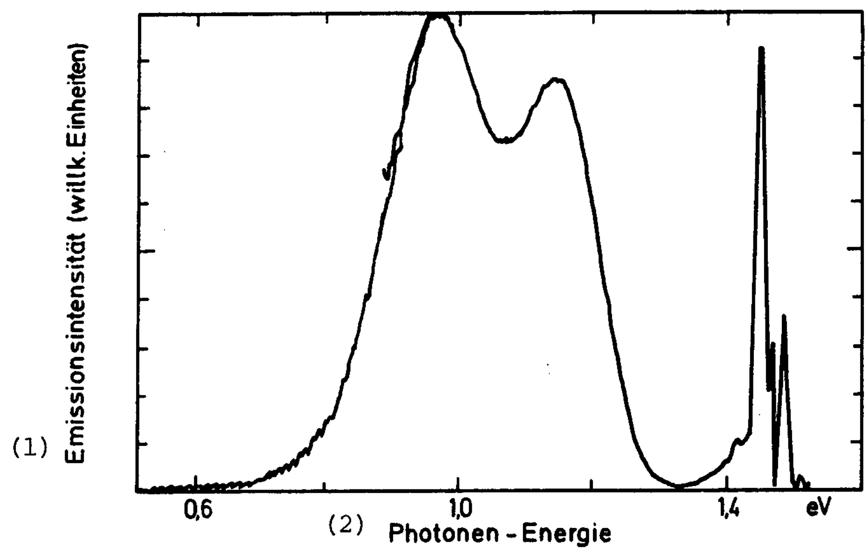

Figure 2.18 Photoluminescence Spectrum of an Undoped MOCVD Layer on n+ Substrate

Key:
1. Emission intensity (arbitrary units)
2. Photon energy

With an increasing [As]/[Ga] ratio, the 1.15 eV maximum becomes weaker in relation to the 0.95 eV maximum.

Emission from the EL2 level is expected in the range 0.6-0.65 eV, but we were not able to observe this. With the previously indicated density of 8 x 10^{13} cm^{-3} (see 2.6.4), this luminescence is probably below the detection limit.

2.7 Preparation of Layers for MESFET's

For use in integrated circuits made from GaAs, epitactical layers must be sufficiently uniform (variation in the pinch-off voltage $\leq$ 10 percent); because it must be possible to regulate the electronic properties in a reproducible manner. The influence of the substrate--for example, dislocations, Cr doping--should be as small as possible.

As described in 2.6.2, the background doping is a function of the [As]/[Ga] ratio. With [As]/[Ga] ratios of 1.5 to 3, it is possible to produce

relatively high-ohmic material. We have used such material as a buffer layer between the substrate and the active FET layer: Figure 2.20 shows the doping profile of such a structure. An undoped, high-ohmic buffer layer was grown with [As]/[Ga] = 3 and with a thickness of 2 μm. Then [As]/[Ga] was raised to 7 and H_2S was added to produce the active layer. The growth rate was about 0.05 m/min for both layers.

Such structures were made up into MESFET's (see 5.1.2). The MESFET results show that the buffer layer is even less doped than pictured here. The profile in Figure 2.20 was obtained by C/V measurements; no correction was made for the influence of the series resistance or the Debye length. In any case, the carrier concentration falls from 1×10^{17} cm^{-3} to 1×10^{15} cm^{-3} in a distance of less than 300 nm.

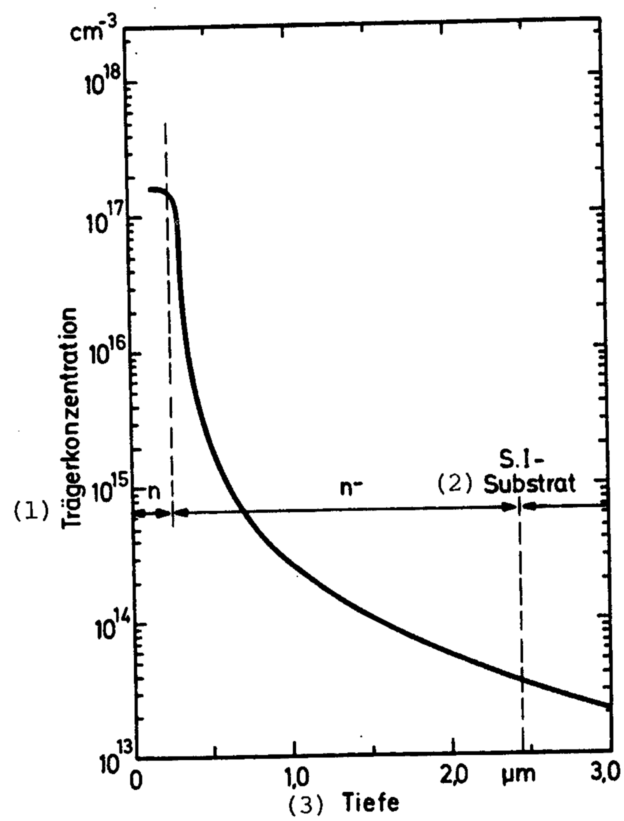

Figure 2.20 Profile of a Layer for MESFET's, (n/n-/S.I)
n-layer [As]/[Ga] = 7, n- layer [As]/[Ga] = 3

Key:
1. Carrier concentration
2. S.I substrate
3. Depth

2.8 Assessment of MOCVD for GaAs IC's

The studies (see 6.2) have shown that the procedure of MOCVD epitaxy for integrated circuits on GaAs is a very suitable process. Moreover, it can be assumed that the charge-carrier mobility reaches that of the other growth methods, with a more improved quality of the initial MO compounds.

In this case, good results could be achieved without having to use low pressures. The system employed here is distinguished by reproducibility from layer to layer and controllability in the growing of thin layers.

Basically it can be stated that the method of metallo-organic epitaxy not only is fairly low-cost and industrially exploitable, but can even be used in connection with relatively high throughputs.

7 Concluding Observation

It is undoubtedly true that the methods of integration on GaAs will lead to components that will make accessible new applications in digital and analog circuitry in the field of ultra-high frequency engineering. Such a development is still linked very closely at present with improvements in the technology of materials (GaAs substrates, implantation, epitaxy). In this respect, an important feature of the above-described study can be seen as lying in having shown how the procedure of metallo-organic epitaxy can lead to industrially exploitable components. From this, many possibilities present themselves with regard to the designing of integrated components with thin layers in micrometer and millimeter wavelength ranges.

12114
CSO: 3698/102

EC ASSESSES CURRENT HIGH TECH PROGRAMS, PLANS R&D THROUGH 1991

Assessment of EC Research Results

Brussels EEC INFORMATION MEMO in English Mar 86 P-18, pp 1-5

[Article: "Assessment of the Results of Community Research and Development"]

[Text]

Community funded research and development is be no means limited to a few spectacular programmes with catching names like JET, ESPRIT, BRITE and RACE.

On the contrary, Community efforts in this field are made up of a vast and complex variety of mutually interlocking research actions and programmes for which the master plan is the Community R&D Frame-work Programme 1984-1987 adopted by the Research Ministers of the Ten in July 1983.

This is the picture emanating from a recent report on assessment of achievements under the various Community research, development and demonstration programmes, approved by the Commission and submitted to the Council and the European Parliament.

The Commission has as part of its work of preparing the second Frame-work Programme for the period 1987-1991, under the auspices of Vice-President NARJES, Commissioner responsible for research and science, reviewed the recent performance of the current RD&D programmes. The present report is the result of a single, broad-spectrum exercise quite distinct from the independent evaluation to which each individual research programme is periodically subjected, but results of such evaluations have been taken into account where available. The Council and European Parliament may use this report in their deliberations leading to the adoption of the new Frame-work Programme.

The adoption of the first Frame-work Programme led to a substantial advance in the RD&D activities of the Community with the added benefit of developing and realigning the overall effort. The annexed table I shows the actual resource allocations made in the period 1984-1985 to each of the seven strategic goals of the Frame-work Programme as compared with the target goals accepted as a planning guide by the Council in 1983 and with the situation in 1982.

Significant features are a doubling of the resources allocated to promotion of industrial competitiveness (to which the Commission attaches particular importance), a reduction in the level of resources allocated to improvement of management of energy sources and a build-up of resources devoted to stimulation of R&D efficacy.

Apart from the appearance of the major industrially oriented programmes like ESPRIT and BRITE which have led to the introcudtiton of important new management methods in order to ensure active participation of industry in the research programmes, new lines of action like biotechnology, medical research and public health, science and technology for developing countries and S/T stimulation have been successfully launched. However, a number of actions have had to be terminated during the review period, like the Super Sara project, the hydrogen subprogramme, and some lines of work on solar energy. A notable reduction has taken place in the work on reactor safety.

The different research programmes have been carried out in the form of direct actions, indirect actions and concerted actions. Direct actions signify that research takes place in establishments of the Joint Research Centre (JRC) importing on this Centre a key role in the execution of the Frame-work Programme. Indirect actions signify cost-shared research taking place in national laboratories. Concerted actions are those where the Community role is limited to that of inspiration and coordination.

Pressure for diversification of modes of action have led to better focussing of disciplines and increased recourse to pilot-scale projects. Finally, the arrangements for advice on management and coordination with national programmes have been substantially rationalized and streamlined at the beginning of 1985, with a considerable reduction in the number of advisory committees.

The report gives an account of the achievements of the individual programmes, grouped into a number of broad programme areas, including a programme summary and short assessment. Results of COST projects have been taken into account where appropriate. The FAST programme has been the subject of a separate evaluation report recently (COM(86) 10).

A brief overview is given below:

PROMOTING INDUSTRIAL COMPETITIVENESS

The encouraging achievements so far of the programmes ESPRIT, BRITE and RACE are well known, but work in important areas like standards and reference materials which are in constant demand for industrial purposes has continued in both the nuclear and non-nuclear field.

Research on steel, high temperature materials and substitution materials has led to improvements in cost competitiveness and increased Community independence vis-a-vis imported raw materials. An interesting example is the development of highly wear-resistant titanium nitride coatings which may increase the service life of cutting tools by a factor of ten.

Under the programme of biotechnology, several achievements have been made in a short time-span, such as a methodology for new vaccines, development of a second generation bioreactor for the synthesis of valuable compounds, and establishment of techniques for genetic engineering methods in plants. They contribute to the industrial as well as agricultural competitiveness and reveal new important interfaces between agriculture and industry.

IMPROVING THE EFFICICACY OF THE COMMUNITY'S SCIENTIFIC AND TECHNICAL POTENTIAL.

More than 1000 transnational research linkages have been established demonstrating convincingly that it is possible to break down the barriers limiting the effectiveness of European science.

Taken overall, the review shows substantial progress being made, both in respect of policy goals and in respect of methods and implementation. Only halfway through the 1984-1987 Frame-work Programme achievement of the goals is by no means complete.

DISSEMINATIONS AND EXPLOITATION OF RD&D RESULTS

A particular chapter of the report is devoted to the crucial question of dissemination and exploitation of RD&D results. It is quite clear that the Community programmes can only attain their real value if the new information and results obtained are used well beyond the population of those carrying out particular projects.

The measures undertaken by the Commission to promote efficient dissemination and exploitation fall in three broad categories:

- diffusion of research and demonstration results (scientific reports, conferences, data bases),
- protection of R&D result (patents),
- actions to promote the use of inventions (licences).

Table II gives an indication of the utilisation of RD&D results.

EC Research Program 1987-1991

Brussels EEC INFORMATION MEMO in English Mar 86 P-21, pp 1-7

[Article: "Commission Specifies Its Concept of the Science and Technology Community"]

[Text]

Against the backdrop of what virtually amounts to a world wide explosion in the need for science and technology, which necessitates a balanced distribution of work between the Community and the Member States, the Commission has adopted a communication to the Council in which it puts forward the guidelines for the second Community framework programme of technological research and development covering the period 1987-1991 and comprising activities which contribute towards:

- European hi-tech competitiveness at international level;
- quality of life in Europe;
- realization of a research workers' Europe.

This communication which rounds off a year of intense and fruitful technology debate in Europe - from the Brussels summit via tha EUREKA initiative and the Milan summit to the Intergovernmental Conference - represents the first stage of a necessary and possible European undertaking: the implementation of an ambitious new European scientific and technological strategy.

NECESSARY, because the scientific and technological capacities of the great economic powers over the next decade will largely determine their ability to secure growth and jobs.

POSSIBLE, because of the close cooperation and the climate of mutual trust established in recent years between companies and scientific institutions in the Community as well as between these and the Commission, particularly in the context of programmes like ESPRIT, RACE and BRITE, and also because the Community is the ideal organization for bringing together and committing the required means: coordinated use of human and financial resources, concerted and planned growth of national and Community funds.

The second stage in this process will be the unanimous adoption of a detailed framework programme inspired by the deliberations taking place in the Research Councils in April and June as well as in other Community institutions as regards the scientific and technical approaches, the priorities and balances, and the necessary level of financial resources set out in the present communication.

The third stage will be the practical realization of the Science and Technology Community through the implementation of specific programmes adopted by the Council by a qualified majority.

This approach by no means implies the intention to discard opportunities or promising possibilities for cooperatiaon with non-Community countries. Inherent in the Commission proposals is not only the opening up of Community actions to European countries outside the Community, ensuring thereby the continental dimension.

According to Vice-President Karl-Heinz NARJES, Commissioner responsible for research and science, it is high time for an offensive European research and innovation strategy specifically aimed at the objective of international competitiveness. The Community is bound to slip further behind unless major supplementary efforts in the field of Research and Technology are undertaken. There is a need for a qualitative leap brought about by the time factor and the heavily distorted competitive situation.

AIM OF THE COMMUNICATION

The Council resolution of July 1983 which approved the first Community R&D framework programme provides for a midterm review of the programme. The events of 1985 which eventually led to the inclusion of research and technology in the amendments to the Treaty of Rome opened the way to simultaneous coordinated development of Community scientific, technological, industrial and commercial policy. Consequently, the moment has come to present the guidelines for the second framework programme in preparation of a formal proposal to be submitted to the Council and Parliament in July of this year.

EUROPE IN THE INTERNATIONAL CONTEXT

Although Europe as a major world trading power can point to some very impressive results in terms of exports, monetary stability, inflation control, investments, productivity, R&D potential, etc. there is no denying that until a few years ago the importance of strong R&D for a growth economy was largely ignored. Unless an all out effort to rectify this is undertaken forthwith Europe runs the risk of becoming a subcontractor in projects which it does not have the means to gear to its own interests.

The scale of the effort now required to catch up with our formidable partners on the world scene must not be underestimated. In fact there is no single European country, however big, which is capable of facing up to todays technological challenges on its own. Five recent trends may help appreciate the scale of this effort:

- the acceleration of the innovation process;
- the proliferation in all economic and social activities of new technologies which are subject to an extremely high rate of evolution (informatics, biotechnology, materials);

- the acceleration of the tendency of productive activities to be developed on a world wide scale;

- the rise in the number of non-material activities, i.e; the rapid increase in jobs in the service sector;

- the growth in defence programmes and their repercussions as regards the world system of research, science and technology.

The last trend can by no means be ignored considering the "dual use" aspects of results from military research programmes which means that resources devoted to such programmes are a direct subsidy to the industries which implement them.

Some figures of R&D expenditure could serve to demonstrate the magnitude of the stakes involved: The 12 Community Member States should be devoting around 230 milliard ECU of public funds to RD&D in the period covered by the framework programme, whereas their gross domestic expenditure on RD&D, showing considerable differences between individual countries, is estimated at twice that amount, i.e. 430 milliard ECU. Comparative figures are 1 000 milliard ECU for the US and 330 milliard ECU for Japan, meaning that at a comparable GDP the Community is trailing behind both its major competitors.

But also from the USSR and other countries emerging gradually in the fields of science and technology, like Brazil, China, India, Korea, Mexico, etc., the Community faces intensifying international competition through innovation.

IMPLEMENTATION AND FINANCING ARRANGEMENTS

The actions adopted in the framework programme will be implemented not only by means of the existing arrangements but also through a number of new procedures based on the European Single Act.

Current procedures are direct action, shared-cost projects, concerted action and demonstration projects.

Direct action takes place in the Joint Research Centre the role of which is under review by the Commission who is preparing a new JRC multiannual programme to be executed in phase with the new framework programme.

The shared-cost procedure is obviously the one used in most cases; it makes possible an optimal use of the limited

resources available to Europe by combining the resources of industry or national institutes and those of the Community (ex. ESPRIT, BRITE, RACE).

The new range of proposed actions calls for a set of new more flexible and better adapted procedures some of which are already identified:

- Joint Undertakings, extending to the EEC Treaty the system laid down under the Euratom Treaty (ex. JET);

- supplementary programmes, extending to the EEC Treaty an instrument already existing under the Euratom Treaty and effectively enabling variable geometry participation;

- supported concerted action involving support from the Community budget amounting to 10-20% of the costs of the action;

- integrated actions covering all of the activities developed in a given research sector by the Member States;

- minority participation by the Community in national and multinational actions or projects;

- innovation loans (ex. NIC IV);

- certain facilities emanating from new Commission initiatives in financial engineering.

To complement all of these procedures the Commission intends - based on experience acquired over a number of years - to strengthen the system for evaluation through independent experts of its research programmes and the results thereof, on a systematic and regular basis.

A range of measures accompanying the implementation of RD&D programmes are envisaged, like all initiatives appropriate to the organisation of the great internal market; specific activities or support measures of particular interest to those states or regions of the Community whose specific and technical development calls for special efforts (ex. STAR; use of ERDF and PIM for certain infrastructure projects, creation of new financial arrangements to support infrastructure projects, and also meet the needs of SME; ways and means for systematically involving laboratories or firms in less favoured regions); measures concerning SME with a view to involving them in the progress of the Community and allowing them to exploit the Community's internal market potential to the full (ex. certain percentage of contract appropriations for shared-cost

programmes reserved for SME, improved information for SME, stimulation of technology transfer, possibilities of association); increased support for the training and retraining of research workers (postgraduate researchers and scientists).

EUROPEAN COOPERATION ON SCIENCE AND TECHNOLOGY

Strengthening Community R&D action does not imply that the Community intends to close the door on the outside world as far as science and technology is concerned. On the contrary, it is envisaged to enhance international, particularly European, cooperation with the European Science Foundation, ESA, CERN, Council of Europe on the one hand, and bilaterally with the EFTA countries through the implementation of the new framework agreements for scientific and technical cooperation on the other. Elaboration of the framework programme will take particular account of two interesting initiatives for multilateral cooperation: EUREKA and COST.

EUREKA

In line with the EUREKA charter complementarity between Community action and EUREKA projects should be introduced at scientific and technological activity level.

The Community remains open towards EUREKA and is ready to make constructive contributions in the framework of the Treaties and the great internal market ensured by these. The Community is in a position to help to get EUREKA projects off the ground while at the same time pursuing and expanding its own activities. Moreover, it will be able to help implement EUREKA projects by offering Community finance and examining the use of measures such as the opening up of public contracts, the setting up of investment companies, the harmonization of taxation systems and standards, providing EUREKA and Community projects with the legal and economic environment that will optimise the expected effects.

Cooperation within COST which goes back to 1971 combines the advantages of a flexible procedure, of variable association between States and of participation by non-Community countries (EFTA countries in particular) in the scientific and technical activities of a wider Europe.

In spite of the profound changes in the background of COST over the years there must be provision in the future for a symbiosis between Community programmes, COST and EUREKA projects. COST, an avenue of activity to which the Commission attaches great importance seems particularly suited to

- highly specific activities which are limited in time and are not well adapted to inclusion in the Community's major long-term programmes and which are unable by their very nature to share EUREKA's background owing, e.g., to their distance from the market.

- activities in areas inadequately covered, if at all, by Community programmes (ex. transport, aquaculture).

The direction in which to steer COST in the future and its interlocking with the new framework programme need careful consideration.

The Commission proposes that seven basic lines of action, within which priorities and programmes will be chosen, be adopted for the establishment of the Community's S/T strategy over the period 1987-1991.

These lines of actions are indicated in detail in the attached table. The Commission is of the opinion that the Community in the period in question must assume commitments in the order of a total of around 9 000 mio ECU plus a small reserve if it wants to meet the internal and external challenges.

The ensuing increase in Community R&D expenditures can due to the Community budgetary situation only take place gradually. The commitment of the necessary funds during the programme period will therefore have to be staggered according to the budgetary situation at the time.

COMMUNITY ACTIVITIES	Activities (million ECU)
1. MANAGEMENT OF RESOURCES	
1.1 Agricultural and fish resources	90 - 180
1.2 Raw materials	60 - 90
2. ENERGY MANAGEMENT	
2.1 Fusion	1060 - 1200
2.2 Nuclear fission	600 - 700
2.3 Fossil, new and renewable energy sources and rational use of energy	250 - 350
3. COMPETITIVENESS OF INDUSTRY AND SERVICES	
3.1 Information technology	2200
3.2 Telecommunications technology	1000
3.3 Integration of information and telecommunications technologies for new applications and services in the common interest	700 - 900
3.4 Cooperation in basic research in information technologies	40 - 50
3.5 Technologies for the manufacturing industries and special technologies	600 - 900
3.6 Biotechnology and agro-industrial technologies	350 - 460
3.7 Materials science and technology	200 - 300
3.8 Marine science and technology	token entry (1)
3.9 Transport	50 - 80 (2)
3.10. Scientific standards and reference materials and methods	300 - 350
4. QUALITY OF LIFE	
4.1 Health	140 - 160
4.2 Safety	230 - 280
4.3 Protection of the environment	285 - 320
5. SCIENCE AND TECHNOLOGY FOR DEVELOPMENT	
6. EUROPE'S SCIENTIFIC AND TECHNICAL POTENTIAL - A RESEARCH WORKERS' EUROPE	
7. GENERAL SUPPORT FOR SCIENTIFIC AND TECHNICAL DEVELOPMENT	
7.1 Innovation	80 - 150
7.2 Communication and information networks and scientific databases	20
7.3 Linguistic problems	80 - 100
7.4 Forecasting and assessment and statistical instruments	30 - 35
7.5 International cooperation	50 - 60
Additional programmes (not financed from own resources) identified at this stage: HFR	100

NOTA BENE:
The Commission shall, in the light of the orientation debates, adopt its definitive proposal on the basis of the scientific and budgetary aspects.

(1) The sum finally decided upon will be taken from the reserve
(2) This does not include the possible future activity in aeronautics for which the sum required would be taken from the reserve.

Esprit Second Phase

Brussels EEC INFORMATION MEMO in English May 86, P-39, pp 1-4

[Article: "The Second Phase of Esprit--Tripling the European Response to American and Japanese Competition"]

[Text]

By 1990, Europe will no doubt be the largest market for information technology (IT) products and services.

It should in fact represent 30 % of the world market for all sectors, ranging from data processing to office and industrial automation, including the new generations of electronic chips.

By way of comparison, in 1985 the market of the OECD countries for IT products alone was worth some 440 000 million ECU. Moreover, experts generally expect the market to grow by 15 to 25 % a year up to the end of the decade.

Nevertheless, unless appropriate measures are taken quickly, European suppliers will see their share of the European market drop from 22 % in 1985 to 21 % in 1990.

At the same time, according to the latest estimates, worldwide expenditure on R&D in information technologies, estimated at 35 000 million ECU in 1985, should reach some 90 000 million ECU by 1990. This means a huge financing effort by governments. Thus it is estimated that 40 % of the funds allocated to the United States Strategic Defence Initiative, known as "Star Wars", will go into IT.

In response to this challenge, the Commission of the European Communities wants to speed up and intensify the strategic effort in information technology launched in 1984 in the form of the Esprit programme.

The Commission considers that the effort required to achieve the objectives of the second phase of Esprit will be 30 000 man-years, which actually represents a threefold increase in relation to that for the current phase of the programme.

In this connection, Vice-President Karl Heinz Narjes stressed that "industry, with the confidence gained through experience, is ready to undertake much more ambitious R&D projects than hitherto, in order to respond to the acceleration of technological progresse and increased pressure from competitors in this area". He added that not only industry, but also administrations of the Community countries has asked for the programme to be stepped up.

Essentially, Mr Narjes believes that the success of Esprit justifies an earlier start than planned for the second phase of the programme.

"In spite of the short timespan since the programme was launched", he said, "(two and a half years, whereas the objectives refer to e ten year perspective), it is already possible to state that this programme has enabled us to bring forward common standards, develop systems and produce results, including patents, and to encourage and stimulate promising new technological and industrial cooperation within the Community".

"In short," stresses Mr Narjes, "compared with action taken at national level, the Esprit strategy offers added value, both by pooling financial and human resources that have so far been dispersed and by broadening the range of options".

Greater emphasis on users' need applications and support to small and medium-sized firms

The three main objectives of Esprit remain :

- to provide European IT industries with the basic technologies to meet the competitive requirements of the nineties;

- to promote European industrial cooperation in precompetitive R&D;

- to pave the way for the introduction of international standards of European origin.

Furthermore, in the second phase of Esprit, the Commission intends to attach greater importance to IT applications and technology transfer, especially in support of small and medium-sized businesses, and in general to take greater account of users' needs.

Here the lesson of Esprit is clear : for many industrial or university organizations, participation in an Esprit project constitutes the greater part of their research effort. Without Esprit, these organizations would not have the necessary resources to conduct research and would not be able to enjoy the advantages of international cooperation.

Indeed, at least one small or medium-sized firm is involved in over half of the Esprit projects, and such firm carry out over 25 % of the work in 60 % of the projects in which they take part, which demonstrates their key role in technology transfer.

The broad ouline of Esprit phase two

The approach proposed by the Commission aims to cover precompetitive R&D in the following areas in particular :

- microelectronics and computer peripherals,
- data-processing systems,
- applications technology, including industrial and office automation.

The key role of the new electronic chips

Among the range of applications that will be necessary to keep European industry in the race with its American and Japanese competitors, the new generations of electronic chips have an essential part to play.

Thus, European industry must be capable of :

- supplying integrated circuits for complex specific applications, containing up to four million basic components on a single chip;

- producing data-processing systems quickly and economically, reducing by a factor of ten the development cost of certain "sub-products" such as microprocessors and software modules;

- exploiting the prospects of industrial and office automation by supplying specific - or what the experts call "generic" - components for a wide range of information-technology applications.

Jobs and information technologies

In its communication addressed to the Twelve Member States, the Commission pointed out that IT, besides being an important industry in its own right, also makes a significant contribution to the competitiveness of most economic activity. The following sectors already depend heavily on IT to maintain their competitive position :

- banking and insurance
- telecommunications
- machine tools
- the motor industry
- aeronautics
- medical and optical instrumentation.

Furthermore, IT is increasingly becoming a cause of social change. Its integration with other technologies has led to be emergence of new applications and services in sectors such as education, transport and medicine.

The Commission also draws attention to some interesting employment figures : jobs in the Community, data-processing, office-automation and semiconductor industries rose by 40 % between 1980 and 1984.

'Sprint': Innovation, Tech Transfer

Brussels EEC INFORMATION MEMO in English Oct 86, P-77, pp 1-2

[Article: "Commission Wants To Give New Impetus to Innovation and Technology Transfer in Europe"]

[Text]

The European Commission has just approved a proposal for a Strategic Programme for Innovation and Technology Transfer, SPRINT, which initially will cover a two-year period with a budget of 11 million Ecus and provide for the continuation and intensification of actions under the "Plan for the transnational development of the supporting infrastructure for innovation and technology transfer". This plan, adopted in 1983, is an experimental plan which has been very successful but which expires at the end of 1986.

Innovation - a crucial factor for industrial competitiveness

Innovation is one of the crucial factors contributing to the maintenance and the improvement of the competitiveness of European "traditional" as well as high-technology industries. Technology transfer is a vital element in the innovation process. Whatever the technical instruments used, technology transfer is essentially a human activity, as it is people that possess and develop the know-how in question.
In this field, exchanges - above all of a transnational type -are often a necessary part of the process, it being difficult to innovate in a vacuum. This is why one of the 26 actions of the current transnational innovation plan was designed to create human networks of consultants specialized in technology and management and working with small and medium-sized enterprises. So far, 170 such consultancy bodies, both public and private, have joined the Community network.

Initiatives such as this must be continued and this is why the Commission, acting on a proposal from Vice-President NARJES and Commissioner MATUTES, has just approved the formal proposal for the SPRINT programme (1987-1988).
SPRINT is principally a transition programme to allow the Commission, in collaboration with economic operators in the Member States, to table proposals for a more consistent innovation promotion programme in Europe from 1989.
It constitutes a vital part of the Commission's response to the challenge laid down by Heads of State and Government at their Luxembourg meeting in December 1985, when the Community set itself the task of strengthening the scientific and technological foundations of European industry and promoting the development of its international competitiveness.

The main lines of action for SPRINT

These lines have been drawn up taking into account experience gained during the implementation of the transnational innovation plan mentioned earlier, when it was found that Community action in the field of innovation can lead to the expected positive results, although the full potential will never be reached unless European innovation policy - like any other infrastructure policy - is based on a long-term strategy and financed in accordance with the importance of the project and the benefits expected.

Therefore, the proposals for a further five-year programme will be prepared during the two years covered by the transitional phase of SPRINT, parallel to the implementation of the main lines of action under this phase, which are as follows:

- development of transnational cooperation between national or regional advisory services and bodies to the benefit of innovating firms, in particular small and medium-sized enterprises, in the Community, in order to optimize the development of such firms and create an innovation process at common market level;

- improvement of the general innovation environment in the Community and acceleration of production and dissemination of new products, procedures and services by strengthening or supplementing existing structures and instruments;

- encouragement of consultation between the Community and the Member States in order to promote European cohesion, combat regional disparities and ensure full participation by peripheral regions;

- integration of the new Member States into current projects by means of measures designed specifically for this purpose.

The proposed funding of 11 million Ecus, which take account of the Community's current budgetary situation, may seem small in relation to what is at stake, but past experience shows that by fully playing out its role as a catalyst the Community is capable of adding significantly to the value of national programmes currently in progress or under preparation in fields such as innovation.

Race: 1990's Integrated Broadband Communication

Brussels EEC INFORMATION MEMO in English Oct 86, P-80, pp 1-3

[Article: "Race: Preparing the Ground for Integrated Broadband Communication in the 90's"]

[Text]

For the emerging global economy, telecommunications represents the single most important infrastructure, requiring an investment which runs into hundreds of billions of ECU. In Europe alone, establishing an integrated broadband communications by 1995 is estimated to necessitate an initial investment of well over 100 billion Ecus.

Clearly, the fundamental importance of a telecommunications infrastructure and associated European and even international standardization for the creation of the unified internal market by 1992 cannot be overestimated.

Furthermore, the telecommunications system and services are playing an increasing role in the evolution of social and economic structures - as well as for defence. This gives this sector a fundamental strategic importance, where Europe cannot afford to be second to any other region in the world.

Obviously, a task of such magnitude and strategic importance cannot be approached without thorough coordinated planning and preparation.

Conscious of this the Commission has for two years been holding discussions with the Member States, the network operators and the sector's industry, directed towards the evolution of an overall telecommunications policy. One aspect of this policy is the implementation of a development programme covering the technologies required for the establishment of broad-band networks.

It is against this background that the Commission has just approved for submission to the Council a proposal for a programme of Research and Development in Advanced Communication Technologies in Europe, known as the RACE Main Programme, which follows on the RACE Definition Phase adopted in July 1985 and due to expire at the end of this year.

The proposed programme will cover the period 1987-1991 and foresees contributions to the financing of pre-competitive and pre-normative work up to a maximum of 800 million Ecus which corresponds, at a cost-sharing of 50%, to about 10 000 man years of effort.

The specific goal of RACE

The thrust of RACE is towards establishing on the world market a strong, or even leading position of the Community telecommunications manufacturing, operating and service industries in integrated and broadband communications, that is the use of advanced technology to transmit voice, data and images at high speed and at low cost.

This will be on the basis of the accelerated development of a strong and competitive Community market for telecommunications equipment and services.

Based on this the specific goal of RACE is to make a major contribution to: the introduction of Integrated Broadband Communication (IBC) taking into account the evolving Integrated Services Digital Networks and national introduction strategies, progressing to Community-wide services by 1995.

Clearly, advances in telecommunications will contribute to regional development within the Community, and the development of the IBC offers a wide range of opportunities for small and medium-sized companies in manufacturing and in the provision of specialized services troughout the Community.

Paving the way for the RACE Programme

The RACE Definition Phase has been successfully implemented. About 400 leading experts from 109 administrations, companies and organisations have worked closely together in order to establish a base for a common strategy of operators and industry with respect to services, infrastructure and standards; to explore the main technology options both on the level of basic technology as well as that of systems; and to initiate an evaluation of the economics of advanced telecommunications.

The contents of the RACE Programme

Of the required initial investment for establishing IBC about one tenth, i.e. 10-15 billion Ecus will be dedicated to developing the technology to be able to offer advanced services at reasonable costs. Of this amount by far the largest part will be invested by industry in R&D towards commercial products and by operators and service providers to develop attractive services. Within this, RACE addresses selectively, but inside a coherent overall concept, those activities which offer a significant advantage when taken up at a Community level.

Thus, building on the results and dynamics of the Definition Phase, RACE is divided into three parts each having their specific role and emphasis in the overall context:

Part I : IBC development and implementation strategies

This part relates to the development of functional specifications identifying the logical interworking and performance of a system without necessarily relating to a particular one. It further addresses systems and operations research towards the definition of proposals for IBC standards, concepts and conventions conforming to an open systems approach permitting the connection of equipment of different origins. It finally covers the analytical work necessary to help establish interoperability for IBC equipment and services.

Part II : IBC technologies

These cover the technological cooperation in pre-competitive R&D addressing key requirements of new technology for the low cost realization of IBC equipment and services. This comprises enabling and supporting technologies like specific integrated circuits, optoelectronic devices, broadband switching techniques, etc.; communications software technologies; basic technologies for IBC users like audio/video processing, communications display technology, digital image recording techniques, etc., as well as subsystems.

Part III : Pre-normative functional integration

This part covers pre-normative cooperation in the realization of an "open verification environment", designed to assess functions, operational concepts and experimental equipment with respect to functional specifications and standardization proposals arising from work in part I.

Complementarity with the ESPRIT Programme and relevant results from that programme will be used to the utmost to enhance work under the RACE Programme.

The Commission will establish <u>for each year</u> of the programme -and update as required - <u>a workplan</u> defining the detailed objectives and the types of projects and actions to be undertaken. Projects will normally be executed by means of <u>shared cost contracts</u> with a maximum Community contribution of 50% of the total expenditure. The contracts will be awarded by open tendering procedure and shall involve the participation of at

least two independent industrial partners not all established in the same Member State. The intention is to achieve the same kind of cross-fertilization through trans-frontier cooperation which has resulted from the ESPRIT Programme.
A review of the programme after 30 months is envisaged.

RACE and other European collaborative undertakings

In order to achieve the goal of the RACE Programme as stated above work under this programme will be coordinated where appropriate with that taking place in the framework of EUREKA. One exemple is the development of High Definition Television.

In addition to this, participation of companies established in EFTA countries in RACE projects will be possible based on modalities to be negotiated.

Further, the Community may conclude agreements with non-Member States participating in European cooperation in science and technology (COST) with a view to ensuring concerted action between the Community activities under the RACE Programme and the relevant programmes of such states. In fact, telecommunications is already the subject of COST actions.

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EC 1986 ESPRIT CONFERENCE, 201 PROJECTS OUTLINED

Brussels INFORMATION in English 1 Oct 86 DG XIII/483/86 pp 1-42

[INFORMATION is a publication of the European Economic Community's Directorate General XIII]

[Article: "ESPRIT Conference 1986"]

[Text]

The ESPRIT Conference, held in Brussels from 29 September to 3 October, has been attended by more than 1000 participants from 16 countries.

"The ESPRIT programme has generated even more enthusiasm than anticipated and, in fact, has been consistently over-subcribed by a factor of five since it began, just two and a half years ago. Indeed it has taken off faster than expected and is ahead of schedule by almost two years.

"This year's ESPRIT Conference is a clear confirmation that concrete and demonstrable results are already coming through. This conference also shows how the momentum of ESPRIT is really being felt by Europe's IT industry," Jean-Marie Cadiou, Director of ESPRIT, said today.

The 86 technical papers and technical demonstrations of more than 20 projects prepared for this year's ESPRIT Conference have shown some impressive indications of the results already being achieved, even though many of the 201 current ESPRIT projects have only recently been launched. Some of these indications are as follows:

In micro-electronics, novel components resulting from ESPRIT research into gallium arsenide chips may be used in the development of the next generation of super-computers by the world's leading super-computer manufacturer. And a novel ESPRIT method for designing complex chips much faster and more reliably has been used for the latest high-quality filter in the Philips compact disc player.

The PCTE project - one of the very few major software projects in the world which has delivered all its results on time - is well on the way to providing software engineers with an answer to one of their biggest problems. This is that the tools of their trade, which allow them to create better software faster and more productively, often cannot be used with the existing equipment and working methods preferred by software companies, because of incompatibility. The PCTE is a kind of universal joint for software engineers - the level of interfacing developed by the project is leading towards an almost universal working environment, independent of any particular manufacturer or machine, which also integrates different design methods, software tools and project management techniques.

When ESPRIT began, "expert systems" were only commercially available from the USA. Now there are at least two in Europe that compare with the world's best, or, in the case of the OMEGA project, set new international standards of performance. Under ESPRIT, the European inventor of the Prolog Language, selected by the Japanese as the programming language for their Fifth Generation computer project, is working with Mercedes-Benz and Bosch on an expert system for the diagnosis of engine failure.

A world standard for the mixed voice-text-image electronic document of the future integrated office is emerging under the office systems sector of ESPRIT. Developed by the HERODE project, this office document architecture standard has been adopted by ECMA and taken up as a draft ISO standard, while a number of major European companies are already implementing it under the PODA project.

Sophisticated software and inter-active techniques can play the role of a teacher, with infinite patience and encyclopaedic knowledge, for home or school use. One example is on display at the ESPRIT Conference - the BBC's Domesday project, the first attempt for 900 years to update William the Conqueror's complete inventory of Britain, has been developed from technology created under an ESPRIT project.

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These are outline indications of the results already being achieved now that the first phase of ESPRIT has built up to its full momentum, with almost 3000 researchers at work on the programme.

ESPRIT : BUILDING MOMENTUM

The European Strategic Programme for Research and Development in Information Technology, ESPRIT, is an industrial cooperation programme which aims to promote the IT industry of the European Community.

The EC adopted the first phase of ESPRIT in 1984 and it was conceived for a 10-year period (1984 - 1993) with three objectives :

- to provide European IT industry with the basic technologies it needs to meet the competitive requirements of the 1990s;
- to promote European industrial cooperation in IT;
- to contribute to the development of internationally accepted standards.

For the first phase of the programme an overall effort of ECU 1500 million was foreseen, with the Community's research budget providing 50% and participants providing the remaining half.

Since the beginning of the programme there have been two major open calls for proposals, which have meant evaluating more than 1000 proposals submitted. By the middle of 1986, 201 projects were underway in the areas of microelectronics, information processing systems (software technology and advanced information processing) and IT applications (computer integrated manufacturing and integrated office systems).

The **initial success** of ESPRIT has been the promotion of trans-European cooperation between IT organisations in the consortia of the projects. Aside from universities and research institutes there are now 240 different industrial partners; 130 have less than 500 employees, which puts them in the small and medium-sized enterprise category. The number of professionals at work on ESPRIT projects reached its peak of 2900 for phase I by mid-1986.

According to all indications, this ESPRIT-initiated trans-European cooperation has enabled more ambitious research projects of broader scope to be instituted and has accelerated their execution. Work-sharing between partners has increased overall cost effectiveness in spite of the overheads needed to set up cooperation.

This cooperation fostered by ESPRIT would not, of course, be of lasting value if it failed to produce concrete, deliverable **results.** Projects nearing completion have met their targets and almost all of the projects are meeting their envisaged milestones on schedule. A detailed account will be provided in a forthcoming Commission report on "ESPRIT Progress and Results", due to be available in late October. Meanwhile, a bird's eye view may be useful.

In <u>microelectronics</u>, the main projects which aim at the development of complete processing silicon technologies are in submicron CMOS technology, a high performance CMOS-bipolar process for VLSI circuits, and submicron bipolar technology.

An example of a delivered item is the design of a demonstrator - a 10K-gate array bipolar chip with 200 picosecond access time, characteristics which compare with the best in the world - completed by January 1986. As a spin-off from this R&D project, a new line for the production of these arrays is being built by Siemens, at a cost of around ECU 100 million. Development of prototypes is planned for next year, to be followed by full production.

At the end of the work on the "Compound Semiconductors Materials and Integrated Circuits" project all the milestones have been met. These are :

- fully operational 1K SRAM in MESFET technology with 3-6 ns access time and a typical power consumption of 80 mW;
- 19 stage TEGFET circuits with gate delays of 20 ps;
- 19 stage heterojunction bipolar circuits with delays of 50 ps.

This has already had an industrial impact : an agreement has been announced between one of the partners, Philips and Cray Research, the leading US supercomputer manufacturer, to develop application specific ICs for the next generation of supercomputers.

In <u>**information processing systems**</u> a significant shift is now evident in the product development strategies of a number of key European companies to ensure maximum benefit from the collaborative work being undertaken within ESPRIT. The most visibly significant output of the programme in this area so far has been the results of work on a "Basis for a Portable Common Tool Environment" - the PCTE project.

The results obtained have gone beyond meeting the original goals to spawning extensive complementary work both within ESPRIT and elsewhere.

- Prototypes of the PCTE have been developed and evaluated;
- The specifications of the development environment interfaces have been completed;
- A first version of the PCTE was demonstrated in December 1985;
- A commercial implementation of PCTE, EMERAUDE, was produced by GIE-Emeraude and released to the market in September'86 - a prime example of timely exploitation of ESPRIT R&D results by industry.

The PCTE work is having wide industrial impact. The specifications of development environment interfaces are being adopted by other Member State R&D programmes (eg. Alvey) and are the subject of ongoing discussions with the Ada (the European originated US Department of Defense language) community.

Through the work on PCTE a major industrial group, known as the X-Open group [1], has been formed to support the adoption of a standard UNIX operating system interface for computers developed by the European manufacturers.

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(1) The X-Open group currently consists of six European companies (Bull, Philips, Olivetti, ICL, Nixdorf, Siemens) and DEC and Sperry from the US.

In **IT applications** results were obtained over a wide range, both in computer integrated manufacturing and office systems. Of particular interest are the results on **standards**. The work in the Multimedia Office Document Architecture based systems (ODA) was aimed at defining a multimedia document standard. It was an early ESPRIT project (handling of mixed text/image/voice documents based on a standardized document architecture : HERODE) which developed the European (ECMA) and worldwide (ISO) office document architecture draft standards. While further work is being done to expand the ODA standard, a powerful on-line auditor and tools have been built to define, manipulate, store, retrieve and transmit ODA documents.

Although a small part of the overall CIM effort, standardization in this area has also been particularly promising. The work on CNMA (Communication Network for Manufacturing Applications) has brought together major IT vendors and users with strong links to the US National Bureau of Standards and the General Motors MAP teams to implement factory communications protocols. A draft implementation guide is already available.

The impact of ESPRIT on standardisation is being felt internationally. By finding a common voice, European industry is in a very good position to take a leading role in the definition of world standards in IT and to exploit the resulting market opportunities.

ESPRIT is paving the way for a European Technology Community. This means creating and promoting transnational opportunities for European companies, leading to technological renewal and economic competitiveness. As such the dynamic role of small and medium-sized enterprises is self-evident. ESPRIT is laying the ground for technology transfer, and encouraging small and medium-sized enterprises (SME) to participate. Over half of all ESPRIT projects count the participation of at least one SME.

In order to achieve the overall objectives, to maintain the current momentum of ESPRIT and to meet the requirements of increased international

competition, the Commission is proposing a second phase to be started in 1987. An important point to arise from industrial consultations on the potential work programme was the repeated expression of willingness on the part of industry to devote substantially more of its resources to collaborative R&D. The size of the critical mass effort required is estimated to be 30,000 man-years. A substantial portion of resources will be applied to a limited number of technology integration projects (TIPs) with concrete, visible goals. TIPs will require large-scale industrial efforts of a Community dimension, tight management and major commitment from the partners undertaking them.

A programme aiming at the competitiveness of the EEC IT industry must be selective and focused on those sectors which offer the best potential for business opportunities or provide the basic technologies needed for establishing a competitive position in the most promising market segments. The orientation of ESPRIT is based on such a demand-driven strategy.

While ESPRIT activities continue to focus on R&D at the precompetitive level, they need to be seen as elements in this demand-driven strategy. The efficient integration of IT into application systems is regarded as the ultimate economic goal, where the role of IT directly supports and interfaces with the user's activities in business, production and other fields, and where an R&D programme such as ESPRIT at the precompetitive level can prepare the ground for success. Application-specific programmes (e.g. RACE, DELTA) can build on these technologies.

By relating to the demand-creating strategically relevant areas, the programme can simultaneously ensure that :

- a growth potential and synergies with other industrial sectors are guaranteed. Factory automation and integration of information technologies in the office, business and home environment are regarded as the locomotive areas to be taken into account by the second phase of

ESPRIT; other selected application sectors would play a test-bed role for technology integration;

- a multiplier effect will be created, so the R&D will stimulate much greater investment and production activity by companies downstream, where the EEC industrial and commercial potential already exists.

Therefore the focus has been directed to enabling technologies, in particular advanced micro-electronics components and peripherals coupled with information processing systems design.

Taking into account the demand-driven strategy, the following specific technical objectives are addressed :

- providing a sustainable capability in advanced components;
- producing technologies and tools for systems design;
- enhancing the ability to use and integrate IT.

Attainment of these objectives is a prerequisite for European manufacturers in IT and allied industries to achieve a self-reliant position for taking advantage of market opportunities in the 1990s and beyond.

The Commission, aware of the strong interest expressed in particular by industry in the EFTA countries for broadening the cooperation in technological research and development, intends to extend the criteria for participation in the second phase of ESPRIT to accommodate them.

ESPRIT is not enough in itself to ensure economic success. Industry and the Community will continue their successful partnership into ESPRIT Phase II. ESPRIT partners will also take advantage of the EEC general policies which aim at providing a coherent framework and a favourable environment in terms of international market, common standards and a common approach to trade policy, which are prerequisite to the translation of R&D work into economic success.

But if the Community provides the framework, and ESPRIT is the innovative structure, European IT industry itself must take up the challenge, organize to win globally and invest for success.

ESPRIT AT WORK

ESPRIT is only in its third year - yet it is already clear that good progress is being made in all areas of the Programme.

A detailed report on ESPRIT progress and results is now being prepared by the Commission and should be available well before the end of 1986.

To provide an early indication of progress so far, the following reports give an overview of a number of projects from each area of the Programme.

The emerging picture shows the gathering momentum throughout ESPRIT. The programme has reached its peak build-up of nearly 3,000 researchers faster than expected and the need to bring forward the second phase of ESPRIT is even clearer in the light of the results already being achieved.

MICRO-ELECTRONICS

Projects to ensure European chip capability

Within ESPRIT, Advanced Microelectronics is concerned with the R&D for producing the components within modern informatics products. Essentially these are the Very Large Scale Integrated Circuits (VLSI circuits); such "chips" are mainly responsible for the enormous increase in the sales volume of informatics products and services, and their improvement in performance accompanied by a decrease in size and, very importantly, cost.

Because of the continuing ability to pack more and more information-handling circuits into the same physical space within a chip, fewer chips are needed for the same or improved performance, leading to much more compact and lower cost products.

From a European strategic and economic point of view, the unpalatable fact is that the majority of advanced chips used in informatics products are produced outside Europe and this trend is set to continue (see diagram 1).

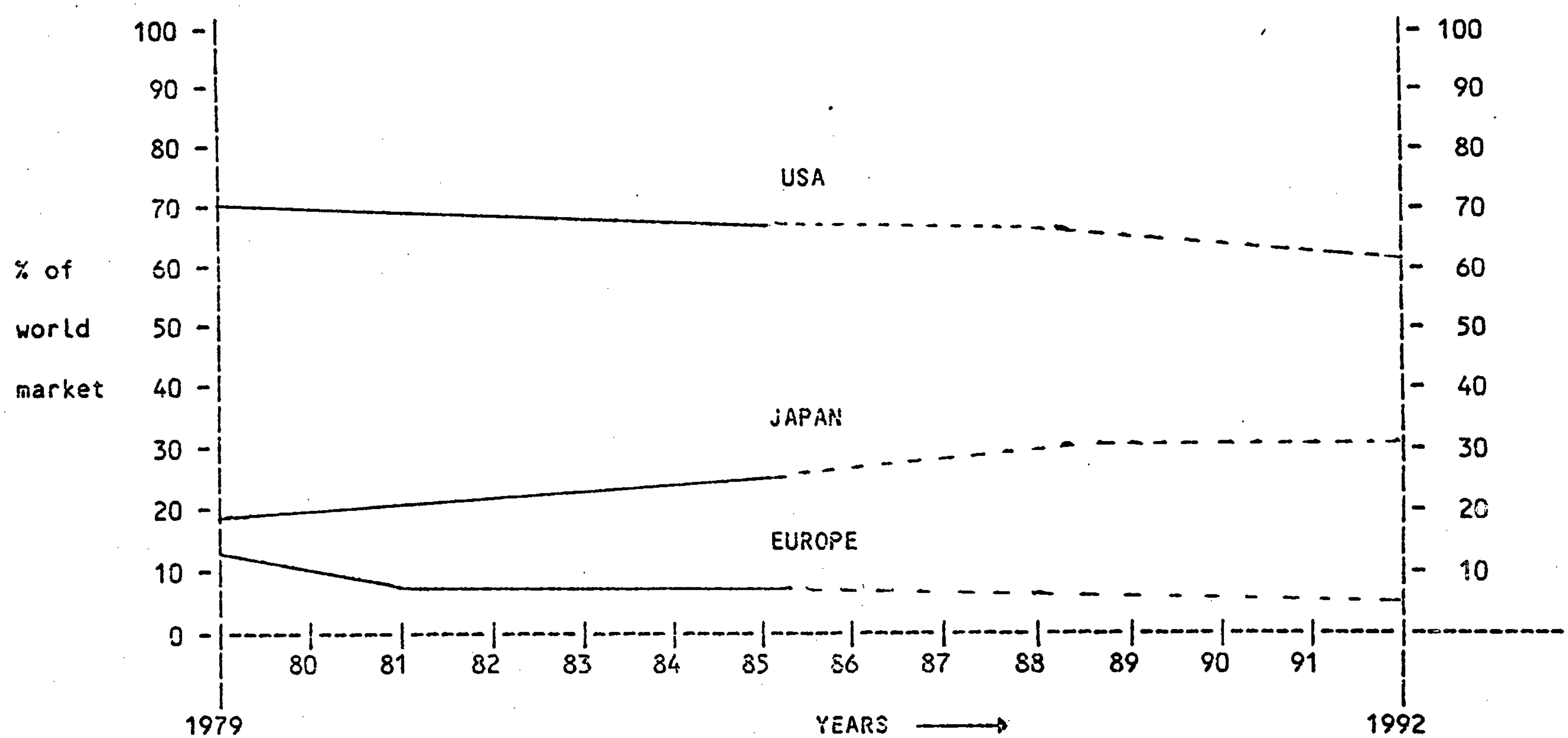
Europe really must improve its position relative to its main competitors or risk having a vital sector of its economy made completely dependent on foreign imports : i.e. if Europe does not spend money on improving chip technology, then others will.

In the Advanced Micro-electronics sector of ESPRIT, one of the main goals is to achieve a very high degree of information handling circuitry within a given space of chip material. This is known as complexity, and is usually enumerated in terms of the dimensions of the basic circuits which must be capable of being sculpted into the material. The term submicron is indicative that these dimensions are to be less than 1 micron (one thousand times less than a millimetre) in size.

D I A G R A M 1

SEMICONDUCTOR CHIP PRODUCTION

Estimates and projections



The 1985 $ 3 billion European controlled production including off-shore and much second sourcing of American and Japanese chips represents only 7.3 % of the world production.

The projection shows this to further decline to 5.5 % by 1992.

Source : a competitive assessment of the US Semiconductor Manufacturing Equipment Industry, US Dept. of Commerce, International and Trade Administration (1985).

If this submicron complexity can be achieved, then chips containing up to several million basic circuits can be produced. The effect of such a capability will be for European manufacturers to have a technology available which would at least match and could surpass that of their competitors, leading to cheaper, more versatile European products.

To give an idea of the present state, current informatics products such as advanced computers and vital components within telecommunications contain chips of up to 2 or 3 micron dimension complexity, although 5 micron is more normal.

Two main strands to the R & D programme are necessary to obtain advanced chips of the required complexity. One is concerned with the machines and manufacturing techniques needed so that chips of the required complexity can be produced reliably and cost-effectively. The other is to ensure that the design capability is in place so that the chips are produced with the correct patterns of circuits capable of providing the functions which are required. This second strand is known as Computer Aided Design for Very Large Scale Integrated Circuits (CAD for VLSI circuits).

Two ESPRIT projects illustrate the above two main strands :

The SPECTRE project

Strategic Project for European CMOS Technology Research and Exploitation

The SPECTRE project is designed to ensure that European industry will have a CMOS capability as advanced as any elsewhere in the world. This implies a need to develop viable submicron processes suitable for the production environment and the main goal is to have workable submicron CMOS processes for Very Large Scale Integration (VLSI) or Ultra Large Scale Integration

(ULSI) by the end of the project. During the project, these processes should have been implemented in the pilot lines of the companies, and their value for mass production proved by the realization of complex demonstrator circuits. The next step for the companies beyond the ESPRIT programme would be to introduce this submicron CMOS into their production lines.

Throughout the project, the new information thus gained regarding submicron CMOS processes will be disseminated throughout seven companies and research laboratories located in four European countries. By means of this project, the capability of producing submicron CMOS circuits at the prototype level will exist in four countries well in advance of a production capability. This will provide a powerful tool for the members of the consortium enabling them to produce the strategic components crucial for the next generation of information technology systems.

Partners in SPECTRE

Centre National d'Etudes des Télécommunications (CNET), France
British Telecommunications p.l.c. (BT), UK
CII-Honeywell-Bull (Bull), France
Matra-Harris Semiconducteurs (MHS), France
Interuniversity Micro-Electronics Centre (IMEC), Belgium
SGS-ATES-Componenti Elettronici SpA (SGS), Italy
Université Catholique de Louvain (UCL), Belgium

Subcontractors

AERE, Harwell, UK
CNR, Italy
Telettra, Italy
University of Aarhus, Denmark

Advanced Microelectronics CAD for VLSI (project 97)

Advanced Algorithms, Architecture and Layout Techniques for VLSI Dedicated Digital Signal Processing Chips

This project aims to provide design capability for an important class of chips used widely in telecommunications. The design aids, or "tools", will allow the complete development of a range of digital signal processing chips. Each tool is tailored to the specific requirements of each step in the design process and to each type of chip.

ESPRIT project 97 has brought together experts in the field of digital signal processing. One of their first results, a "CAD Tool Box", was a set of Computer Aided Design computer programmes. This toolbox helps in the automated design of digital filters. The expertise which is normally needed to do the job is embedded in computer programmes, not only capable of taking complete care of the filter design starting from the specifications, but also meeting the main requirements of the industry and of the customer of today, i.e. small size and low cost. The CAD Tool Box tackles the cost problem at all levels. It not only allows the designer to create a filter, starting from specification and bringing it to the point where it is ready for production, in less than a week compared with several months by previous methods, but also builds a filter with a minimal size, so as to reduce the amount of silicon needed to produce it. The result is already being used by Philips as a product.

The benefit this brings to the consumer market follows directly out of our introduction : cheaper telephone, cheaper television, cheaper video recorders and cameras, etc.

Partners in project 97

Interuniversity Micro-Electronics Centre (IMEC), Belgium

SILVAR-LISCO N.V., Belgium

Ruhr Universitat Bochum, Germany

BELL Telephone Manufacturing Co, Belgium

PHILIPS Research Laboratory, Netherlands

SIEMENS AG, Germany

In micro-electronics, many technological problems clearly need to be overcome to meet the demands for ever-increasing performance and ever-decreasing size and price. The micro-electronics area of ESPRIT, including projects working on the newest developments in silicon technology, compound semiconductors and CAD for VLSI, is of fundamental importance, since these new technologies are paving the way to the future.

What an IT company wants is to be on the market with a new product before its competitors. To be able to do this, it wants to have at its disposal the most powerful CAD system for VLSI. This system must be able to design - almost automatically - a working circuit of enormous complexity, with minimal size and a optimised performance. Furthermore, as the chips produced must be tested, the system must take account of this need also, and it must communicate with the user in an understandable, friendly way, so that it may be easily used. All this is wishful thinking... it does not exist... yet.

The ESPRIT CAD for VLSI projects are working hard to get closer to this goal, using newly developed design techniques (e.g. parameterised building blocks libraries). In the past it was felt that the development of these CAD tools could be done by the individual groups or organisations : this was indeed true in the past, but only up to a certain complexity. Above this complexity the problems increase exponentially and a strategy of optimising the resources must be followed, implying cooperation and sharing of the results. Because of the cooperation now underway, companies have CAD system capability at their fingertips, consistent with current design needs.

The ECIP project

ESPRIT is going further. Each company normally has its own particular requirements, so that CAD tools never meet their complete requirements. A solution for this is to create the possibility of assembling a personalised CAD system. The ECIP project under ESPRIT is working on standards for the interchange of designs and of CAD tools. The idea is to put forward some standards in Europe which will allow CAD tools developed by different organisations to be assembled into one personalised CAD system. This approach not only solves the problem of the very personal requirements each user has, it also allows economic use of scarce resources and less duplication of parts of the work. Thus people can concentrate on the real problems, without losing time on realising general parts. Clearly the ECIP project will provide a multitude of possibilities for future exploitation.

Partners in ECIP

BULL, France
ALCATEL, France
ICL, U.K.
PHILIPS, Netherlands
SGS MICROELETTRONICA, Italy
SIEMENS AG, Germany

The CAVE workshops : the "ESPRIT effect" at work

Since May 1983 the Commission has sponsored a series of technical workshops known as the CAVE workshops (Computer Aided design of VLSI in Europe). The special aim of these workshops, which are held twice yearly, is to provide a vehicle for disseminating the results of projects involving CAD (Computer Aided Design) of VLSI (Very Large Scale Integration). Originally these projects were supported under the Council Regulation 3744/81 on Micro-electronics, but the advent of the ESPRIT programme provided the impetus which has ensured the continued relevance of the series of workshops.

The scope is, however, not limited to projects with Community funding. The Commission provides support for the travel costs of attendees to ensure that it is equally easy for experts from all Member States to attend the workshops. Local expenses are paid by the attendees themselves.

The workshops are also aimed at fostering personal relationships at a technical level in order to smooth the path of future collaboration in the Community in R&D in CAD for VLSI. This results in a series of workshops which are rather different from the normal run of specialised technical workshops. In order to be successful the CAVE workshops must attract a kernel of attendees who will attend regularly so that good personal relationships can be built up. Fresh input of ideas is ensured by reserving some of the places for additional specialists currently working on the particular topics for discussion, regardless of whether they are regular attendees or not. Frank exchange of the most recent results is the prime purpose.

Therefore, rather than focusing on a single narrow topic, a broad range of topics from the field of CAD for VLSI is covered at each workshop. In order to promote CAD activities throughout the Community and to take advantage of various local expertises, the location of the workshop is rotated throughout the Member States. A Technical Committee comprised of representatives from all Member States and a local organiser from the host State assist the Commission in the organisation of the workshops.

Seven workshops have now been held and the series has proved most successful in binding together the specialist community of researchers. The size of the workshops is limited to about 60 people in order to ensure an informal atmosphere with maximum possibility for easy discussion. The reputation of the series is such that many requests for attendance have to be turned down each time. The opportunity to obtain a twice yearly update on most of the major research activities in the field in Europe has proved a very attractive magnet.

A large component of the work reported at each workshop has been supported by the Commission under one or more of its programmes in micro-electronics, but the most significant contribution of the series may be that it has created the first opportunity for the complete range of research in Europe in this field to be intimately reviewed on a regular basis. Thus the results of work in programmes such as ESPRIT can be seen in the total Community context and bonds between Community funded work and other work can be strengthened.

INFORMATION PROCESSING SYSTEMS

Software Technology

Through ESPRIT, Europe has the opportunity to turn a promising technical lead in a very important aspect of software engineering into a strong world market position.

The ESPRIT Software Technology programme has concentrated on the development of new methods and tools aimed specifically at improving software development productivity and software product quality. There are currently more than 40 projects underway within the programme. At the heart of the programme has been the definition of specifications for tool and user interfaces for advanced development support environments, which provide a more appropriate working environment for engineers engaged on the design of complex systems. Industrial experience in the development of these systems has, in the past, given rise to the so called "software-crisis".

The very important work on the specification of common interfaces for development environments has been carried out within the PCTE project (basis for a Portable Common Tool Environment) which started in 1983. The

project has produced prototype systems each of which conforms to the standard interface specifications. These prototypes have proven the interfaces sufficiently for their specifications to form the basis for standardisation within Europe. The interface specifications have been released into the public domain and an independent management body is currently being formed to take control of the specifications and to direct their future evolution.

Through the PCTE and related projects, more than 20 European IT companies are working in one way or another with the PCTE interfaces, providing a significant industrial base for the emerging products.

The availability of the PCTE interface specifications is particularly important at this time in view of the current discussions concerning the interface standards for the ADA support tools. It is important in this context to note the availability of the first commercial product on the market fully supporting the PCTE-derived interfaces - the EMERAUDE environment.

Partners in PCTE

Bull, GEC, ICL, Nixdorf

Advanced Information Processing (AIP)

Within the ESPRIT programme the Advanced Information Processing area concentrates on the development of new methods and techniques for the next generation of IT products.

The present range of products are capable of handling numbers and text, providing quite adequate facilities for numerical calculation, word processing, etc. The demand is now for systems which are able to process

knowledge, i.e. systems which are capable of understanding the meaning of a text and able to draw conclusions from a number of facts. This much higher level of processing requires the development of new methods of man-machine communication (speech, vision); very much higher performance computers; new techniques for data (knowledge) representation; and new computational methods.

The work programme for AIP addresses four main topics.

(i) Knowledge Engineering - Knowledge acquisition, representation and processing methods.

(ii) External Interfaces - The understanding and processing of speech by computers, computer vision.

(iii) Data and Knowledge Bases - Efficient mechanisms for the storing of knowledge.

(iv) Advanced Computer Architectures - Development of very high performance, highly reliable computers and distributed computer systems.

The 42 projects within the AIP sector of the programme are providing the essential links between the industry and the university and research laboratory teams working in this area. Through these links the ESPRIT programme is providing one very important mechanism by which the results obtained in the laboratories will be quickly utilized by the product manufacturers. After just two years of the programme, European industry is seeing benefits from the ESPRIT projects in this area.

- The logic programming language, BIM-PROLOG, is being marketed with the appropriate support tools and independent evaluation of the product has indicated that this is one of the most efficient PROLOG compilers on the

market today. The efficient support of PROLOG is a key topic covered by the programme. A number of projects are underway which are enhancing the language definition to include numeric processing capability, interfaces to relational databases and bindings with graphic interface standards. Other projects are developing logic programming environments for the efficient support of the language.

- The OMEGA expert system shell (a basic building block for the development of expert systems) is available commercially.

- Within the advanced computer architectures area project 415 (Parallel Architectures and Languages for AIPs - A VLSI Directed Approach) has been in progress since 1984, and has brought together six of the major European IT companies to specify and develop a new range of computer architectures which will effectively support logic, functional and object- oriented programming styles. An object oriented language compiler has been produced and is being used to develop a parallel VLSI simulator. This project is also complementing the other projects working with PROLOG. A PROLOG compiler has been developed for target parallel computer architectures.

An AIP Story

Knowledge Engineering aims at developing knowledge based systems. Generally speaking, these are systems which are able to provide guidance on the solution of problems in fields where high level expertise is often in short supply (e.g. medical diagnosis) or highly complex process control (e.g. nuclear power station performance monitoring). Knowledge obtained either from experts or from available data can only be used by such a system if it is properly represented. Thus Knowledge Representation is an important part of Knowledge Engineering and an area of work for the ESPRIT Advanced Information Processing (AIP) subprogramme.

Logic, the oldest form of knowledge representation, has provided the basis for one of the newest programming languages used for this purpose: it was originated in Europe (by the Colmerauer group in Marseilles in 19871) and has since been adopted by the Japanese (their 5th Generation project is based on it) and - in part - the U.S. Artificial Intelligence programmes. This language is known as Prolog (from Logic Programming) and is particularly useful for building Knowledge Based Systems when suitably enhanced. A number of ESPRIT projects have produced state-of-the art versions of Prolog and associated tools. The results - so far - of the LOKI(1) project provide an illustration:

- Three new formalisms were developed, including STRUDEL which is used to support a computer aided design system for aircraft.

- A parser-generator pair (LOQUI) for English and German to support access to databases in natural language and of a constraint propagator mechanism used for the aircraft design application (ADROIT).

- Development of tools to support inspection of knowledge structures suitable for the project management application and to support explanation facilities in ADROIT.

- A first prototype of the aircraft design system, restricted to wing design, is already complete.

- The Belgian Institute of Management (BIM) has recently released BIM-Prolog, a Prolog development system including a compiler. The object code produced by this compiler executes faster on standard benchmarks than the object code produced by any other Prolog compiler in the world.

In another project(2) from the Knowledge Engineering area led by Professor A. Colmerauer, the originator of Prolog, Daimler-Benz and Robert Bosch were brought together with GIA GIT and Prolog IA to further develop

Prolog into a new language (Prolog III) and then test it by building a knowledge based system for the diagnosis of failures in automobile engines.

This topic, concerned with how a computer communicates with its environment, is the subject of the External Interfaces area of the AIP subprogramme.

Data coming from the environment, transmitted as signals to a computer, have to be analyzed and interpreted. Conversely, in order to transmit information to the outside world, the computer has to synthesize appropriate signals. Work in this area covers image, speech, optical and multisensor processing. An interesting example of ESPRIT work in 2-dimensional image processing is the recent development(3) of a set of algorithms to process X-ray images of blood vessels. Part of the originality of the system is the use of the knowledge of the organization of the blood vessels to control the different processing levels and the successful application of new reasoning techniques from Knowledge Engineering. A first prototype based on the "transputer" (a processor that can be networked with other identical ones) has been designed to implement the system efficiently. Thomson-CSF has been working on the project in relation with CGR, a leading company in medical engineering.

The third area of AIP in ESPRIT is <u>Computer Achitectures</u>. Until recently the demand for an increase in computer performance has been met by the development of computers which run their instructions in a set of sequential steps (so called von-Neumann computers). It is now becoming evident that a high degree of parallel execution of instructions must be achieved to meet the need both for conventional, but much faster, numerical processing tasks and for the processing of symbols and knowledge. The architecture of parallel processing is a main goal of the work in this ESPRIT area (as well as of the Japanese 5th Generation programme and many of the US DOD-sponsored projects). Most of the ESPRIT effort is concentrated in one major project bringing together 11 partners from five different countries(4).

The project started in 1984 with a review of existing and emerging architectures in order to combine the different techniques in support of all three programming styles (object-oriented, functional and logic). Other results obtained results obtained so far include:

- A PROLOG compiler that can be installed in a variety of parallel computer architectures.

- A compiler for an "object-oriented" language (one allowing communication between abstract objects like data-types, programme modules etc.) This compiler is now being used to develop a simulator for VLSI chips with parallel hardware architecture.

Aside from its very ambitious technical objectives this project is paving the way for a European consensus on advanced architectures which will provide the framework within which a common European position for future standards can be established.

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(1) Project 107 "A Logic-Oriented Approach to Knowledge and Data Bases Supporting Natural User Interaction". BIM (B), Fraunhofer Institut IAO (D), Scicon (UK), University of Creta (GR), Cranfield Institute of Technology (UK), SCS (D), INCA (D), Technical University Munich (D).

(2) Project 1106 "Further Development of Prolog and its validation by KBS in technical areas"

(3) Project 26 "SIP Advanced Algorithms and Architectures for Speech and Image Processing"

(4) Project 415 "Parallel Architectures and Languages for AIP - A VSLI Directed Approach" AEG Telefunken (D), CII-HB (F), CSELT (1), CWI (NL), GEC (UK), University of Munich (D), LIFIA (F), Nixdorf (D), Philips (NL), Stollman & Co. (D), University of Berlin (D).

ESPRIT I IT APPLICATIONS

Computer Integrated Manufacturing

Communications between computers are always complex, especially in industrial automation, when different types of computers from suppliers all over the world are used for the many and varied functions involved in manufacturing - from computer aided design workstations to controllers on machine tools, robots, and automated handling and storage equipment, via common databases and management computers. The problems are compounded by the geographical distribution of some industries: plants spread across several countries often have to work together in a coordinated fashion to meet business demands. But the achievement of good communications in this environment is essential if computer integrated manufacturing is to be realised - with all its associated benefits of massive cost reductions, improved flexibility and quality, and reduced response times to customer demands.

A number of initiatives have been launched in recent years to address such communication problems. All now recognise a basic, structured model of communications defined by the International Standards Organisation, known as the Open System Interconnection (OSI) 7 layer model.

Two of the most publicised initiatives have their origins in the USA - the MAP (Manufacturing Automation Protocol) programme led by General Motors, and the TOP (Technical and Office Protocols) programme led by Boeing. At the start of 1986, these programmes were complemented by a major European project within the ESPRIT programme, under the title CNMA - Communications Network for Manufacturing Applications.

The CNMA project "Communications Network for Manufacturing Applications"

The CNMA consortium is a powerful combination of equipment users, vendors and other institutions. Users include British Aerospace (prime contractors),

Peugeot, Aeritalia and BMW; vendors include Bull, GEC, Nixdorf, Olivetti and Siemens. System engineers CGE-TITN and the Fraunhofer IITB are also members of the consortium.

CNMA complements MAP and, to a lesser extent TOP, by concentrating on very early use of the specifications and standards being developed by these other initiatives. For example, the MAP programme is currently working towards the adoption of a new specification, to be known as RS511, for use between machine tool controllers, robots, etc and supervisory computers. This will become part of the Version 3 MAP specifications to be released next year. CNMA has been working on the use of these specifications since the start of this year, initially using a pilot application within a British Aerospace factory, but now also addressing applications in BMW and Aeritalia. The combination of mini-computers, controllers and other equipment supplied by the vendors to satisfy the requirements of these applications is providing a very rigorous test of the specifications well before they are finalised as International Standards, allowing this experience to be fed into the final definitions.

As a first result of this process, the CNMA consortium is now making available, via the ESPRIT Directorate in Brussels, an Implementation Guide detailing the profile of standards and specifications adopted by the project, and advising on the way these should be used to achieve interworking between multi-vendor equipment.

The consortium plans to unveil more of its work at the next Hanover Fair in April 1987, where part of the British Aerospace pilot application will be on display. This demonstration will show equipment from each of the vendors participating in the project, communicating to control a real manufacturing cell. Later in 1987, the complete pilot will be on display for six months in a British Aerospace plant in Preston in the north west of England.

End users of industrial automation equipment, contemplating the purchase of equipment from different suppliers, need to be confident that interworking will be possible. The verification of conformance to such communication

standards is still in its infancy and presents a number of difficulties. By also developing and implementing the necessary conformance test tools, CNMA is providing early experience in testing to the new standards, which will ultimately help to establish international testing services.

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Partners:

British Aerospace	UK
BMW	D
Olivetti	I
Peugeot	F
Aeritalia	I
Siemens	D
Bull	F
CGE-TITN	F
GEC	UK
Nixdorf	D

The AMICE project: "European Computer Integrated Manufacturing Architecture"

In a unique project, 19 partners are cooperating within the European Community's ESPRIT programme to develop an Open Systems Architecture (OSA) for computer integrated manufacturing (CIM) applications.

CIM users, who want to be able to acquire hardware and software tools from a variety of vendors, are often inhibited by incompatibilities of data formats and communication protocols between the products of different vendors.

The objective of this ESPRIT project is to define a common set of concepts and rules, independent of particular vendors, to facilitate the building of future CIM systems and to provide migration paths for the evolution of already

installed systems. The very wide participation in the project includes leading information technology vendors as well as leading-edge CIM users. The results of the project are therefore expected to be progressively implemented in the specifications of available CIM hardware and software products, and in a wide range of working CIM environments.

A set of CIM scenarios is being provided by the project partners to establish a basis for the development of the planned architecture and to consolidate a European industry view of CIM. Feedback on user requirements is provided by other ESPRIT CIM projects which also act as testbeds for emerging elements of the architecture.

In the initial phase of the project the project team has defined the overall scope of the architecture, the approach towards the development and the specific areas where development effort is needed. One principal target of the project - to establish a coordinated view of the architecture by the major IT vendors and users - has already been achieved. The first major project output - 'CIM Open Systems Architecture (OSA) - Key Concepts' was issued early this year.

Close collaboration is being maintained with the relevant national and international standard activities. The project results are expected to strongly influence the definition of international standards for CIM.

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ESPRIT Project 504: "A Systems Technology for Optimising the Trade-offs Between Plant Availability, Product Quality and Safety"

Downtime of expensive equipment in manufacturing industry could be costing the European Community billions of pounds each year in lost production. Independent surveys in the US and the UK point to an average 11% loss of productivity due to failure of numerically controlled machines. However, new techniques in computer control developed by an international ESPRIT consortium can forecast fault conditions and plan and execute recovery actions in real time. The consortium has recently demonstrated the principles involved on a single machine and the system is now to be further developed for application to a large manufacturing plant environment.

The techniques are being developed in an ESPRIT Computer Integrated Manufacturing (CIM) project. The seven partners in the Plant Availability and Quality Optimisation (PAQO) consortium are integrating a number of new and existing diagnostic and decision-making technologies into a truly fault-tolerant system, with the best possible trade-offs between productivity, quality, flexible use of resources and safety.

The demonstration is at the Advanced Manufacturing Technology Research Institute (AMTRI) of Macclesfield (UK). It conveys the concepts of the PAQO approach and the techniques developed during the first 18 months of work. The demonstration is based on a wide duty range milling machine, representing a simple manufacturing system involving metal cutting and inspection. The results have already demonstrated the successful identification of impending fault conditions and of remedial decision-making during the actual cutting of metal.

A central feature of the demonstration is a unique tactile machine spindle, giving three mutually orthogonal measurements of the forces on the cutting process and on the drive train, and providing indication of:

- individual and overall cutter tooth condition
- errors in relative position of workpiece and cutter
- incorrect depth of cut
- incorrect material characteristics
- cutter collision detection.

The tactile spindle was shown to be capable of detecting not only relatively small amounts of cutter damage during operation but also where that damage was located. In- and post-process control is provided by an air gauge, measuring surface roughness, and a simple binary vision system is used for process inspection.

The principles of the system can be equally be applied to larger units and within the next month, in collaboration with Danobat, the machine tool manufacturing company, work will begin on a two-year programme to implement the technology on an advanced computer controlled manufacturing cell at the Ikerlan centre, Mondragon, in Spain's Basque region.

A fault tolerant system offers a number of financial benefits to manufacturing industry, such as reduction in waste and machine damage and increased productivity through higher machine availability and efficient rescheduling.

The work of the PAQO consortium is focussed on the real-time sensing of fault conditions and the instigation of recovery actions, ensuring that manufacturing systems perform properly at all times. Their work involves operating at the leading edge of many technologies, such as fast database design, CAD/CAM interfaces, sensor design, signal acquisition and processing, real time software, modelling, and advanced information processing techniques for diagnostics and action planning.

The multi-discipline, multi-national consortium comprises: Stewart Hughes of Britain, project leaders and specialists in machinery management technology; AMTRI, a UK centre of excellence in manufacturing and machine tool technology; ADERSA, a French company specialising in process control and diagnostics; Technische Hochschule Darmstadt, a university group specialising in model-based diagnostics; GRS, West Germany, who specialise in real-time software for alarm and disturbance analysis in nuclear power plants; Battelle Institut, West Germany, known for their work in advanced information processing; and Danobat, one of Spain's foremost machine tool manufacturers.

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ESPRIT Project N° 322 : CAD Interfaces (CAD*I)

The CAD*I project within the European Communities ESPRIT programme is making an important contribution to the advancement of computer integrated manufacturing (CIM) by defining common interface requirements for CAD systems.

Many engineering companies are now using computer workstations for computer aided design (CAD) and computer aided engineering analysis (CAE). Such analysis may involve the modelling of a complex product, such as an automobile or an aircraft, on a computer and the use of this model to explore alternative design approaches.

Design data generated on CAD/CAE systems has to be widely distributed to other parts of the company, where it is often used as inputs to other computer-controlled processes. To satisfy various specialised requirements, companies may have several such CAD/CAE systems, from different vendors, each needing access to each other and to data bases of commonly used parts. There are frequently incompatibilities between the formats of the data generated by and required by the products of different vendors. This creates a lot of difficulty and expense and represents a considerable barrier to the introduction of a computer integrated manufacturing (CIM) environment.

The eleven project partners, led by Kernforschungszentrum Karlsruhe, include several suppliers and users of CAD/CAE systems. The main goal of the project is the development and test of a set of powerful vendor independent interfaces, which will allow the exchange of data between CAD systems and also between CAD and engineering analysis systems.

The project partners have presented the results of the first 18 months work in Status Report 2, available from the project leaders. An initial specification (version 2.1) of a neutral file for the exchange of data defining solid models between different CAD systems has been published by Springer Verlag, Heidelberg. Tests of available interface processors, including IGES, VDAFS and SET, have been completed.

An initial specification has also been prepared for the exchange of data between CAD/CAE systems and data derived from the experimental analysis of physical models of the product. This enables progressive refinement of the product model within the computer, where it can be used as a basis for the introduction of product improvements.

A strong collaboration is being maintained with international standardization activities in the field of product definition data exchange and important contributions are being made to the work of the relevant ISO Technical Committee.

A number of currently available CAD systems have been used as a basis for the investigations, including: BRAVO! (Applicon), CD 2000 (Control Data), EUCLID (Matra Datavision), ICM (Control Data), MEDUSA (Computer Vision), PROREN (ISYKON), ROMULUS (Shape Data), STRIM (Cisigraph) and T 3000 (Norsk Data Dietz).

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Office Systems

Multimedia office information

The development of Office Systems based on informatics is leading the evolution from the traditional paper-based document towards an "electronic document". We can see it on the screen of the terminals, we can write it on the keyboard. We can also print it in order to obtain our usual piece of paper, but the trend is toward a "paperless office" where the electronic document flows through workstations and is held in mass, memories.

Early office system were essentially only able to handle typewritten information, but the emerging new technologies also now give the opportunity to produce and handle an electronic document with a mix of traditional text, image (photo-like or graphics) and handwritten notes. In addition, we can attach recorded voice comments to the document. All of that is possible through modern microcomputer-based user intefaces which can handle manual commands, display pictures, accept voice commands and output speech. This new "multimedia" document can be transmitted through a network to other workstations and stored in electronic files.

This technology, which is now available, can hardly be transferable to the market if compatibility is not guaranteed among several units of different manufacturers, integrated into an information system. A need exists to define and validate a standard for coding the different information of a multimedia document.

The HERODE project

One of the early ESPRIT projects (HERODE) has been very actively engaged in this basic research and has contributed substantially to the development of both the European (ECMA) standards and the international (ISO) standards for the definition of what is called the Office Document Architecture (ODA).

The HERODE consortium gained practical experience with the development of an ODA-based system. In particular, a set of software tools has been produced which enable the user to edit a document which comprises a mixture of text, drawings and photographs. Further tools will be added to handle tables of information and voice annotations.

ESPRIT project teams are also developing Automated Document Entry tools which will automatically digitize documents with text, graphic and photographic information. The tools will recognize the various components and segment the individual pages into basic pictures and drawings, coding

them according to ODA rules. The text strings will, after recognition, be further decoded into their character representation and can then be further manipulated.

The PODA project

Another ESPRIT project, PODA, is transferring this basic research to a domain which is more related to application, in order to foster short-term industrial impact. It involves the implementation of the ODA standard, under the UNIX operating system, in an essentially portable manner. The project team includes the major industrial groups Siemens (Germany), Bull (Frqnce), Olivetti (Italy), ICL (UK) and CGE-TITN (France)

ESPRIT action is supporting a rapid broadening of ODA acceptance. As an example, in the United States the TOP committee has already expressed its interest in including ODA in the TOP specifications. The strong cooperation in a worldwide leadership position if the common efforts are focused in the proper direction.

THE PODA Project

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Office Communications

Ten R&D projects involving 800 manyears of work have been launched in ESPRIT office communications, six in early 1985 and four in early 1986. Work is under way in network architectures, distributed operating systems, gateways and bridges, and network services provided to users. The main strategy underpinning the office communication sub-programme aims at supporting an overall architecture where multivendor components can be integrated. These activities are based on the OSI concept and relevant standards that have been developed with the close involvement of European manufacturers and users.

A coherent set of four projects addresses specifically the development of advanced communication systems for the future office and business environments :

- "Broad site local wideband communication system - BWN" (no.73),
- "An integrated network archictecture for office communication - INCA" (395),
- "Local integrated optical network - LION" (169)
- "Ultra wideband optical coherent LAN - UCOL" (249)

They cover different requirements ranging from the short term integration of multiple local area networks (LANs) and switching systems to the long term very high bandwidth able to support multiple advanced services including videoconferencing, multimedia document transfer and real time control and monitoring applications. These networks are provided with gateways to the public PTT networks and servers.

The BWN project is developing a local area network capable of serving large industrial, scientific and administrative communities : the project will be able to demonstrate in 1987 a 25 km loop network connecting

multiple LANs and featuring access to the public networks and satellite channels. Transmission rate on the backbone is 140 million bits/sec, and average access rates for all bridges and gateways are above 2 million bits/sec. All components of the system have been specified and the major performance characteristics have been verified through computer simulations. The hardware and software developments are in full swing. The system is unique in a number of its features and attracts international attention. It will be suited particularly for installation on university campuses, science parks and environments with similar characteristics, particularly if several LANs and machines of different vendors have to be connected by a high speed link.

In the INCA project local networks including a PABX-based network are being developed utilising different technologies and architectures. Using this infrastructure, an advanced document handling application will be demonstrated. One of the local networks utilizing CATV technology is being thoroughly tested in the laboratory. This is also the status of a multi-media workstation to be used for the demonstration. A first and limited demonstration is planned for 1987. An early spin-off of the project has been the development of a broadband modem that is likely to be marketed soon.

The LION and UCOL projects both aim at 2-level architecture and utilize optical fibre technology. Both will provide full terminal to terminal complex information transfer and are designed for handling multiple simultaneous services.

However, the UCOL target bandwith is between one and two orders of magnitude higher than LION's and delivery of UCOL prototypes will be 3-4 years later than the corresponding LION prototypes. In project LION the architectures, protocols, network controllers and ISDN-gateways are fully specified and implementation is under way for systems with transmission rates of 140 Mbit/s initially and 565 Mbit/s later, and access rates of 2

Mbit/s, to be demonstrated in 1988 and 1989 respectively. Project UCOL has demonstrated the feasibility of utilizing optical fibre technology allowing transmission rates up to 10 billion bits/sec that will make it possible to carry several video channels. Mixed Time Division Multiplexing/Frequency Division Multiplexing (TDM/FDM) access protocols for UCOL have been fully specified and a new laser technology for the emission of the bit stream has been demonstrated.

The advanced networking techniques developed and validated by ESPRIT projects will underpin a very competitive position of European companies in a large spectrum of applications covering a variety of office environments. The coordinated efforts of European manufacturers and research centres under the ESPRIT umbrella are also fostering a more and more rapid technology transfer from R&D to products addressing all this broad spectrum of emerging opportunities.

The BWN project

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Human factors

For years, the ergonomists working in the European research institutions and universities have been preaching that the market requires and expects IT products which, rather than being "pushed" by the available technology should be "pulled" by the end users' requirements and designed according to their abilities and skills. On the other side, the engineers designing and implementing IT products have considered human factors as nice to have as an add-on to their design, rather than an integral contribution to it.

The ESPRIT research programmes on human factors are having great success in overcoming this gap between ergonomists and designers by bringing them together to work on the integration of ergonomics into the product development process and on the involvement of end-users in the product validation process.

The HUFIT project

The major ESPRIT project on ergonomics, called HUFIT (Human Factors Laboratories in Information Technology), brings together five major European IT companies (Bull Transac, ICL, Olivetti, Philips, Siemens) and six leading European research institutions (Fraunhofer Gesellschaft, Husat Research Centre, Universities of Cork, Munster, Minho, and Athens). Over 130 man-years are invested in these institutions, spread over eight countries. They are working in three areas : development of human factors contributions to the design, development and validation of IT products, development of new interfaces and propagation of knowledge across the IT industries.

The HUFIT project is thereby as a strategic contribution to the European IT industry designed to allow the development of products which meet the requirements of end users much more accurately and much more usefully.

As an example of the work performed so far, we can refer to the analysis of the process utilized in the development of new IT products. This process has been analysed by several of the industrial partners in the consortium. They defined for each of its relevant phases the "human factors contribution" required to improve the eventual compliance of the product to user expectations. The resulting reformulated development guidelines enable design to be centred on user requirements, as opposed to driven by the capabilities of the technology. They offer also to the designer, at each stage of his activity, the methodologies and the tools required to embed ergonomics into the product.

Methodologies include ways to identify usability features that are relevant to the targeted audience and application, ways to determine skills and abilities of the final users, ways to analyse the tasks performed in the target application area and to anticipate the impact of the proposed technological solution to these tasks. The tools made available to the designer include an expert system that enables to identify the usability guidelines relevant to

each design step and to verify the compliance of each feature of the user-computer dialogue to a chosen set of usability criteria.

The above gives an idea on how the human factors contribution can be focussed on the actual user requirements and capabilities.

The knowledge gained by the HUFIT consortium through this ESPRIT project will not be restricted to the 11 partners. Starting next year, an extensive programme of advanced professional training is planned which will allow the transfer of ergonomic skills to the designers of information industry products throughout Europe.

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FRANCE EXPLAINS REFORMS IN CNRS; IN MILITARY, CIVIL R & D BUDGET

Priorities, Plans at CNRS

Paris AFP SCIENCES in French 9 Oct 86 pp 3-6

[Text] Paris--"The CNRS [National Center for Scientific Research] reform bill which I presented to the Council of Ministers has received the prime minister's approval. I felt that the CNRS problem deserved more than a press conference, given the demonstrations and reactions witnessed in recent months," said Minister of Research and Higher Education Alain Devaquet in his October 9th presentation to the press of the reform package for the largest French research institution, which he conceived in cooperation with its new director, Mr Serge Feneuille.

Among the statements and comments made, he emphasized the following points with regard to CNRS goals:

1. The government is determined to preserve CNRS unity, which is "an essential condition" for it to revive leading-edge research and "is also necessary for the social and economic sciences."

2. Its "primary mission [must be] to push back the limits of the unknown in all sciences and scientific fields," an expression the minister prefers to "knowledge production."

3. It must improve its existing symbiotic relationship in its work with the university, and ties with the university must "be strengthened while maintaining a good balance between the two parties."

4. CNRS activities must be more firmly rooted in the economic tissue, much more so than might be believed from the various measures taken in recent years which "have turned out to be more symbolic than effective."

5. It must "develop close, complementary, and balanced collaborative relations with businesses." In his opinion, there is no question of CNRS either heading industrial research projects itself or acting as a mere subcontractor. Joint projects must be developed with businesses "in previously explored fields and in new directions as well."

The reforms envisaged acknowledge and attempt to correct "serious [CNRS] defects" which, if they are not remedied, could endanger the "high quality of its living tissue."

To prevent the "excessive growth of central structures" from widening the gap between the scientific community and "the technostructure that sets research policy," Mr Devaquet and Mr Feneuille will implement reforms which should make it possible to "correct current problems."

To this end, the National Committee will get back to "the tasks of prediction and management"--of defining the body's long-term strategy.

Union power has become too important and will be curtailed, but Mr Feneuille pledged that adequate structures for dialogue, similar to those that exist in industry, will be created to deal with personnel management problems without impinging on the committee's real work.

The role of the committee's scientific subcommittees will be to observe developments in the various disciplines, examine research team activities, and propose the creation or elimination of laboratories, as required by their policies.

All university faculty will once again be eligible to vote in the election of scientific subcommittee members. Persons from the business world will be able to take part, and uninominal voting will be reinstituted for the election of professors and senior-level researchers.

The elected members of these subcommittees will also sit on competitive examination qualifying boards, which will include an equal number of highly qualified scientists. Admission board appointees will be selected strictly according to scientific criteria.

Lastly, the subcommittee chairmen will represent the National Committee at Scientific Council meetings, where they will be seated next to the general director and the scientific directors. These meetings, over which the general and scientific directors will preside, will assist the chairmen in their duties of evaluating and developing scientific policy.

Given the "vague organization" with "poorly defined chains of command" and "complex, intertwining structures that give the appearance of a massive administrative apparatus, when in fact the administrative staff is far from excessive," CNRS's internal organization is to be revised, and a smaller structure that "clearly distinguishes between operational and strategic tasks" will be put in place.

For this reason, as Mr Feneuille recently told AFP SCIENCES himself, he, the "person responsible for the organization's global strategy, will be surrounded by a smaller number of persons working directly with him, who together will form the Executive Committee."

The scientific departments will continue to constitute the operational structures, and their make-up will be revised to reflect better the disciplines

represented. Their directors will once again be expected to go out in the field and to be in contact with laboratories and researchers. Mr Feneuille will begin his first "pilgrimage" trip next week, with a 3-day visit to Lyon and Grenoble.

Lastly, evaluation procedures will be "improved and strengthened in order to ensure greater efficiency throughout the organization."

The new CNRS reforms also take into consideration such factors as handing over the reins from one generation to another, mobility, combatting the aging of the research staff, and career flexibility. Once the necessary laws have been passed, it should be possible to implement the reforms "before the end of the year," Mr Feneuille hopes.

In addition, "the CNRS and its researchers [must] be able to mobilize quickly on scientific topics that are new or important to the future of the nation. The Center must be able to detect events or promising developments, put research teams together quickly, and ensure the dissemination of information."

To do so, the reformers have envisaged:

1. Formulas for fixed-length appointments, particularly at the postdoctoral level (currently under study).

2. The number of thesis internships should be increased, organizing a true "training-through-research" program.

3. CNRS could also recruit very highly qualified engineers, capable of designing and building the scientific equipment of tomorrow and applying state-of-the-art technology.

4. The number of positions reserved for instructors or scientists from the university, other bodies, or foreign countries will be increased.

5. Lastly, CNRS should "better irrigate the university make-up," since many CNRS researchers would like to become involved in higher education, at least at the more advanced levels. "But we must not be dogmatic," Mr Devaqauet emphasized. "We must not say that all CNRS researchers either have to or cannot teach. Individual desires and abilities must be considered."

The minister expressed this wish: "I would like to find a dozen researchers to participate in the election campaign, to go out and tell people all over what research is, basic research, in arts centers and elsewhere. Research must be known and understood. Knowledge has to be passed on."

Mr Devaquet emphasized that these CNRs reforms are part of a much larger context, and that he would soon be defining a general research policy and an industrial research policy before the Council of Ministers. "I am almost ready with both of them," he said.

Reaction to CNRS Reform

Paris LIBERATION in French 10 Oct 86 p 39

[Article by Dominique Leglu: CNRS, New Directions for Use. Alain Devaquet's Package Has Received the Prime Minister's Approval]

[Text] The minister of research and higher education and CNRS's new general director explained the reform bill yesterday: no break-up, back to basic research, and closer ties with the university and industry.

CNRS will not be dismantled. Alain Devaquet, minister of research and higher education, reaffirmed this decision explicitly yesterday morning after presenting his reform package for the nation's leading research institution to the Council of Ministers the day before. This bill, which was written with its current director, Mr Serge Feneuille, "has received the prime minister's approval. He felt that the CNRS problem deserved more than a press conference, (...) given the movements attempting to destabilize it in recent months. It was necessary to state things clearly."

So researchers should in fact feel reassured--especially at a time of increasing criticism within certain rightist organizations. In a statement released yesterday, UNI [National Interuniversity Union], an organization close to the majority, "expresses its disappointment at Alain Devaquet's presentation to the Council of Ministers. The minister did make a vague allusion to this organism's "serious defects," but this quick, superficial diagnosis underestimates the nature and the seriousness of the illness. (...) The only way to breathe new life into French research is to break up the rigidifying, centralized structures."

The current majority is not going to reach a consensus in this area. According to the minister, CNRS's mission is "to push back, for all disciplines, the limits of the unknown--all sciences, including the social and economic sciences, if we must spell it out."

After this veiled allusion to struggles with his extremists, Alain Devaquet went on to state the current government's wishes for CNRS in clearer terms than has been done until now. Its primary mission is basic research. To be successful, CNRS must not ignore its dual ties to the universities on one hand and business on the other.

The reasoning does not seem new. Nevertheless, the minister did aim a few barbs at pre-March-16th policies, stating that "measures taken in recent years [have been] more symbolic than effective." He went on to clarify his remarks. First, he recalled that CNRS had often been accused of criticisms with regard to the university, criticisms in which "for his part, he does not believe."

CNRS General Director Serge Feneuille hoped "that CNRS would now appear as a partner." With regard to the industrial measures, Serge Feneuille felt it important to put an end to "a myth, the myth of the treasures hidden in the laboratories"--(knowledge) deposits to be exploited. Clearly, there is no

question of CNRS heading up industrial projects: "It almost should not even take out patents."

What is needed is for "industry and researchers to work together." The "joint laboratories" formula is favored by the new general director, who has decided "to replace exploitation with the principal of cooperation."

Insofar as the organization's internal structure is concerned, the new "National Committee" should go back to its tasks of "prediction and macroevaluation." This can only be accomplished with a "broader scientific community," or, in other words, with more university faculty and people from the business community.

In passing, the general director launched into a harsh attack on "union power." "Union science is an impossibility," he emphasized. He also felt that there had been a "distortion" of the roles of certain scientific bodies (the National Committee, the Joint Technical Commission, etc.). Without giving any actual details, he implied that what was needed were "true advisory bodies," where union power could be exercised in resolving personnel issues. To make the organization effective again, Serge Feneuille would like to get rid of a whole series of regulations in which "this institution is mired." As concerns CNRS strategy, it is to be directed by "a small group which is partially released from administrative duties."

In order to make this program known at CNRS itself, the general director has tackled the task of meeting with all those to whom "he wants to restore greater responsibility," namely all the laboratory directors, or about one thousand people.

Civil, Military R&D Budget Management

Paris LE MONDE in French 11 Oct 86 p 10

[Article by Elisabeth Gordon: Soldiers' Pay, The Research Budget]

[Text] National research and development expenditures are up 6.8 percent in relation to GNP. Although the current buzzword is "government disengagement," the minister's advisors noted, "this budget confirms that research remains a priority" for this government.

Mr Devaquet would thus appear to be a fortunate minister, especially since a comparison of the figures just made public to those released by his offices in late August (40 billion francs) [LE MONDE 21 Aug] makes it tempting to conclude that Mr Devaquet has managed to double his funding in a month and a half. There is of course nothing to it. The difference is simply due to the interim inclusion of funds earmarked for military research (30.8 billion francs) and other categories (specifically, certain university research staff) that were not previously included. The Descartes Street ministry offices have created a new notion: the Research and Development Budgetary Effort, or EBRD, which covers all government expenditures in these sectors. By doing so, they provide an overall view of the problem, and they also make comparison with preceding budgets extremely difficult.

Nevertheless, it can be seen the big winner is military research, with a 5-billion-franc increase in funding over 1986. Civil research is less well favored. Certainly, Mr Devaquet has managed to "save the furniture," and he has even obtained a 6.1 percent increase in the funds (21 billion francs) under the control of his ministry (most of which go to research bodies). However, the total civil research budget is up only 0.6 percent, which means that other categories are stagnating or regressing. This is essentially the case for aid to industrial research.

Of course, Mr Devaquet's advisors justly note that industry will be the main beneficiary of the spin-off effects from the considerable funding allocated to the Defense Ministry. However, the same companies do not necessarily profit from military research as from civil research. This point is emphasized by the Conseil Superieur de la Recherche et de la Technologie [High Council on Research and Technology]--the group of "sages" who advise the minister. It notes that funds allocated to military research are "traditionally concentrated in a limited number of fields (aeronautics, electronics, nuclear energy, space, etc.), which, it feels, leaves entirely unresolved the problem of aiding other, more traditional sectors or sectors in which France has lagged behind its trading partners (such as agriculture and food production).

The changes in the method of calculating the Civil Research and Development Budget (BCRD) are not without political consequences. This budget used to provide the minister with a lump sum that he allocated to this or that research body, ministry, and so forth. For him, it was a tool for managing his research policy. It is now what some call a "meaningless" aggregate of funds put together by the minister of finance, who thus regains some of the power that had been taken away from him.

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INITIATIVE, INDUSTRY COOPERATION URGED FOR FRG LARGE SCALE R&D

Duesseldorf HANDELSBLATT in German 29 Oct 86 p 6

[Text] There is broad agreement in the Bundestag for the view that the major research institutions in the FRG should develop more independent initiative and undertake an intensive search for ways of cooperating with industry. This was the result of a debate on the government's report on the future development of the major research institutions.

Parliament agreed with the view of the committee for research and technology, which said that these institutions should look for coordinated projects with industry, primarily in information and biotechnology and materials research. A recommendation is also made to the major research institutions to identify industry's longer-term research requirements in a timely fashion and, whenever possible, to consider them when formulating their own plans.

Parliament requested the government to ensure that not only supervisory board chairmen from the ranks of the officials at the Ministry for Research are asked to meet, but also those from science, industry and the economy.

In conjunction with cooperation between the major research institutes, the coalition fractions emphasized that the government should examine the possibility of privatization or of the economy participating in the financing of individual institutes and, if circumstances warrant, implementing this. There should also be a study of whether the management of major state research institutes can be taken over totally or in part by private companies in order to introduce market economy systems of productivity increases and monitoring success.

In the opinion of CDU delegate Josef Bugl, the government's report and a supplementary opinion indicate the direction in which the major research institutes should develop: an orientation to the needs of science, the economy and the state, participation by the economy in major projects and in financing institutions and strengthening autonomous management ability. The CDU/CSU was also asking management, as well as the codetermination committees in the major institutions, to collaborate in ensuring that the programs and functional conditions, which the government was proposing as its offer to improve the structures at the institutions, are fully utilized and end in success.

FDP delegate Karl Hans Laermann went beyond the decisions of the committee and the assembly in his recommendations and pressed for some consideration of whether at least the very large institutions should not be decentralized. Grouping by specialization, for instance, in departments and assigning them greater authority to make decisions could be the push that industry needed to become more heavily involved with life and developments at the major research institutions.

Finally, some consideration should also be given to whether or not there should be a "new nameplate" for some institutions. For example, it was not clear why a Society for the Use of Nuclear Energy in Shipbuilding and Shipping (GKSS) was still needed. Nuclear energy in this area had already declined "to zero."

9581
CSO: 3698/80

ITALY PASSES LAW ON PARTICIPATION IN EUREKA PROGRAM

Rome GAZZETTA UFFICIALE DELLA REPUBBLICA ITALIANA in Italian 11 Oct 86 p 3

[Law No 676 of 11 October 1986: Concerning Italy's Activities in the EUREKA Program]

[Text] The Chamber of Deputies and the Senate of the Republic have approved;

The President of the Republic promulgates the following law:

Article 1

1. An annual allocation of 200 million lire for the participation of Italy in the organizational activities concerning the EUREKA Program is authorized.

Article 2

1. The funds necessary for the application of the present law, equal to 200 million lire annually for the 3-year period 1986-1988, will be supplied through a reduction of the appropriation in the 1986-1988 3-year budget, Chapter 6856, under the reserve funds of the Ministry of the Treasury for fiscal year 1986, by partial utilization of the authorization assigned to "Ratification and Execution of International Agreements."

Article 3

1. The present bill becomes law on the day following its publication in the GAZZETTA UFFICIALE.

The present law, duly marked with the government seal, will be inscribed in the official record of the laws and decrees of the Italian Republic. It is the legal obligation for all persons to observe the law and to see that it is observed as a law of the Government.

Rome, October 11, 1986

[Signed] Cossiga

Craxi, President of the Council of Ministers

Andreotti, Minister of Foreign Affairs

Seen, Rognoni, Keeper of the seals

From: GAZZETTA UFFICIALE DELLA REPUBLLICA ITALIANA 10/21/1986 No 245

8615
CSO: 3698/M043

WEST EUROPE/SCIENTIFIC AND INDUSTRIAL POLICY

BRIEFS

NORWAY TO PARTICIPATE IN EURAM--Next year Norway will begin a joint research program with the EC. Norway's Scientific and Technical Research Council has already been given the green light to participate in a project in advanced materials research. The project will deal with the problem of quick setting for magnesium and aluminum, metal-based composites, and plastic composites. Norway will cover the costs itself. Companies and institutions that participate can receive government subsidies, however. The joint research project is a result of a framework agreement reached last summer between the EC and other European countries. The agreement also permits Sweden to participate in certain EC technological projects. In Norway, there is more and more discussion concerning participation in the EC. [Text] [Stockholm MY TEKNIK in Swedish 30 Oct 86 p 21 9336

BRITE OPEN FOR SWEDEN--Yet another EC technological development project will be opened to Swedish participation. The project, which is called BRITE (Basic Research in Industrial Technologies for Europe), is an attempt to get small and medium companies to utilize new and more advanced technology. This will be accomplished by way of basic research. If companies and institutions from two or more EC countries can agree on joint research projects, then the EC will pay half the costs. After 1 year of the BRITE project, the EC leadership is now proposing that European countries outside the EC also be permitted to participate. An opening toward Sweden and other countries is of "important strategic interest" to European technology as a whole, the EC Commission wrote to the ministers who will make a decision. One problem in this connection is that companies and universities outside the EC cannot count on economic subsidies. Thus, prospective Swedish participants must cover the costs themselves. Among the numerous technological programs sponsored by the EC, ESPRIT (information technology) and RACE (telecommunications) have been opened for Swedish participation. The same conditions are now being proposed for BRITE. The Swedish Telecommunications Service is among the companies now participating in RACE. [Text] [Stockholm NY TEKNIK in Swedish 30 Oct 86 p 6] 9336

CSO: 3698/77

CSSR: LACHEMA ENTERPRISE STRESSES LOW-TONNAGE CHEMISTRY

Prague TECHNICKY TYDENIK in Czech No 42, 14 Oct 86 p 3

[Interview with Eng Pavel Bruzek, director general of the Lachema Enterprise in Brno, by Helena Brabencova: "Orientation Toward Low-Tonnage Chemistry"; first three paragraphs are TECHNICKY TYDENIK introduction]

[Text] The transition to intensive management in the national economy, which has been stipulated by recent congresses of the CPCZ as a basic prerequisite for the further positive element of our economy, presupposes express structural changes be undertaken in the chemical industry. In addition to fundamental chemical production and petrochemistry, it is necessary to orient further development toward sectors characterized by lower specific consumption of materials, raw materials, and energy, a lower degree of the negative influence of their activities upon the environment, and a higher percentage of qualified work.

A new direction in this regard is the production of low-tonnage chemical specialties, which includes, for example, pesticides, pure and special chemicals, photographic materials, coatings, auxiliary substances for industry, organic pigments, pharmaceuticals, chemicals for the rubber industry, catalysts, products for the manufacture of plastics, etc.

In our country, the chemical industry was not structurally adapted to this new task. Consequently, by 1 January 1984, the Lachema Economic Production Unit was established in Brno as a new central management link, specializing in the production of selected low-tonnage chemical specialties. Almost 3 years have passed--sufficient time to permit us to speak about experiences, results, and future outlook. Consequently, we asked Eng Pavel Bruzek, director general, for this interview.

[Question] Comrade general director, which enterprises now are subordinate to Lachema?

[Answer] We have plants at Kaznejov, Neratovice, Bohumin, Blansko, and Brno; affiliated national enterprises include a pharmaceuticals plant at Kolin, the Fotochema Enterprise at Hradec Kralove, and the Monokrystaly special-purpose establishment at Turnov; and as an independent enterprise, we even have the Research Institute of Pure Chemicals in Brno.

[Question] Organizationally, you are a certain experiment, since the management has a direct relationship with production. What is the advantage of this arrangement?

[Answer] We saved one entire organizational step. The management of the economic production unit has direct operational responsibility within the sector enterprise and can, therefore, immediately verify the influence of its decisions throughout the entire economic-production complex. We have mastered our tasks very well during the first 2 years of our existence. Without adjusting the plan, we fulfilled all decisive indicators in 1985, across the board throughout the complex. We exceeded our deliveries to the market with deliveries valued at more than Kcs 250 million and we fulfilled our export assignments, our profit assignments, as well as our adjusted internal output indexes. This was specifically manifested in terms of satisfying the requirements of other sectors. For example, we delivered merchandise worth Kcs 82.8 million to the electrotechnical industry--that is, roughly 8 percent more than was the case in 1984; the health industry received merchandise worth Kcs 50.9 million, which is 16 percent more; and deliveries to agriculture increased by 31 percent in comparison with last year.

[Question] To what extent did innovations share in this plan fulfillment?

[Answer] In 1985, Lachema delivered 48 new products to the health industry, 19 to the electrotechnical industry, 15 to agriculture. One of the characteristic indications of low-tonnage chemical production is the high frequency of the innovation cycle. The average life expectancy of chemical specialties is estimated at 8 to 10 years. This means that all principles and measures, formulated with respect to scientific-technical progress in party documents, must be consistently activated.

[Question] What actually is the mission of Lachema?

[Answer] Our task is to assure selected sectors the necessary chemical specialty products, primarily pure and special chemicals, which are one of the conditions for the application of the most modern scientific and technical findings in industry, agriculture, and in the health industry. Pure chemicals are used today not only as classic laboratory chemicals in the sphere of scientific research work, in controlling laboratories, or in teaching situations--the focal point of their application is being transferred to industry where they serve as pure technological raw materials in industrial processes.

[Question] Could you give us specific examples?

[Answer] Without an assortment of pure and special chemicals, the electronics industry is not even capable of producing anything at all. For example, it is little known that an adequately broad assortment of photoresistant substances, highly pure gases, superpure acids, and solvents is the completely fundamental prerequisite for the production of semiconductors, integrated circuits, and other electrotechnical products.

In the health industry, pure chemicals have prevailed in the application of biochemical diagnostic methods. The comprehensive utilization of the possibilities presented by biochemical diagnostics brought about completely new possibilities for improving the accuracy of diagnoses, for the control of postoperative statuses, for specific pharmacotherapy, and for extensive preventive care.

In agriculture, pesticides are used on a massive scale to protect crops against harmful pests; nonantibiotic growth stimulators increase the utility of livestock by increasing the weight gain of chickens, calves, and piglets; biocidic substances are used to create hygienically nondefective environments in large-scale livestock-raising establishments, etc.

Not even industry can get by without auxiliary products such as, for example, dispersions, mastics, fillers, emulsifiers, etc., of the most varied types, both with respect to technological processes on the one hand and with respect to improving the utility characteristics of the final product, on the other hand.

This brief account of the spheres for utilizing low-tonnage chemical specialty products then leads to the broad theme of the work of our scientific research base which must, therefore, be technically equipped to work in the most varied applicational areas, must have an appropriately narrowly specialized body of workers, and highly qualified analytical chemistry departments.

[Question] Surely that is not quite enough....

[Answer] We must know the requirements of these sectors with relative accuracy and in sufficient time and detail so that our products, the development of which always takes several years, are commensurate with their utility characteristics to the requirements at the time of their application. This is a very complicated problem, primarily because technical development is progressing everywhere very rapidly. I would again use the example of the electronics industry which changes its requirements far more rapidly than the other industrial sectors. Its products are needed for the automation of industrial processes, for the introduction of computer technology, in instrumentation technology, etc. In other words, in sectors in which truly the most recent findings of science and technology are applied. An example of our successful work is, therefore, our own prognostication, the evaluation of information from the application sectors and their confrontation with the general development of scientific findings. From the standpoint of this complex, we then attempt to formulate such tasks for our scientific research base which would meet the above-mentioned criteria.

[Question] The development of low-tonnage chemical specialty products is also expected to lead to better export capabilities, particularly with respect to nonsocialist countries.

[Answer] The work program of our scientific research base includes the development of original chemical specialty products with which we shall be able to compete very strongly with Western chemical firms in the future. It is not

necessary to state in detail that this is a very demanding task. After all, for example, the chemical industry of Switzerland is almost exclusively oriented toward research, production, and sales of specialty chemical products. It not only has a tradition of many years, an appropriate production technical base, but also an appropriate set of contacts in the world market. We are aware of the fact that we will have to adapt to this demanding situation, to utilize the advantages of our system, and to prevail in the face of the competition. I consider one of the decisive advantages to be the possibility for close cooperation with fundamental research--which, under our conditions, is financed by the state. The work sites of the Czechoslovak Academy of Sciences and of the advanced schools are capable of working out original products for us which will fulfill the previously mentioned criteria. For us it then remains to shorten the research--production--utilization cycle to the maximum possible extent by actively taking over the results of fundamental research and by preparing appropriate conditions in the production sphere of the technical base. In this connection it is necessary to stress that the effect of our new research work cannot be expected to materialize for several years, since our existing work was primarily oriented toward how to lower the dependence of the application sectors upon imports from hard-currency areas. For example, we were successful in almost completely eliminating the dependence of the electronics industry upon the importation of photoresistors which were frequently even embargoed. Now, however, we must adopt a proexport orientation.

[Question] How is cooperation with the socialist countries developing?

[Answer] An important task for Lachema is the development of international cooperation, particularly with respect to CEMA countries, among which the USSR assumes a priority position. As far as pure chemicals are concerned, we have already in the past worked our way into the position of the largest foreign supplier of this assortment to the USSR. This primarily involves the most modern products for medical diagnoses, chromatographic materials which continue to form the basis of our classical export assortment. We want to expand biotechnology and also join into the USSR agricultural-food industry program by offering appropriate chemical specialty products from our current and developmental assortment.

[Question] Our market continues to show a lack of quality photographic materials which you produce. Will this situation improve in the immediate future?

[Answer] We are a significant supplier of products for the consumer market. These products include an entire assortment of photographic materials for amateurs, products such as fertilizers for small-scale gardeners, lemonades in powder form, mastics, various sets of chemicals, etc.

The principal problem is presented by photographic materials. In recent years, there has been a significant development in color photography. However, the Fotochema Enterprise was not adequately technically prepared for this change in the market demand since very little was invested in past years in the production of photographic materials. Our great effort is to solve the topical problems connected with covering domestic demand rapidly. For example, we are redesigning production in such a way as to be able to expand the

production of color photographic paper. Modernization should result also in changes in the character of the material so that it would be equal to the products of leading world firms. We are solving the problem of the shortage of cassettes for perforated films. Together with new management at Fotochema, we have worked out a concept for rapid development of production, the basis of which is the erection of a new plant. If we receive the approval of superior organizations, its construction can begin as early as this 5-year plan.

[Question] Comrade director general, what would you say in conclusion?

[Answer] The problems involved in the production of low-tonnage chemical specialty products, their sales, and the assurance of the innovation programs is very diverse. It requires the comprehensive solution of many questions, just as it is necessary to demand that modern chemical sectors must be capable of reacting very readily to newly arising demands. This is the fundamental prerequisite for successful work involving low-tonnage chemical specialty products--and this is also the basic principle for managing the new Lachema Economic Production Unit.

5911
CSO: 2402/14

EMBRABIO MARKETING DNA SYNTHESIZER

Sao PAulo O ESTADO DE SAO PAULO in Portuguese 23 Sep 86 p 32

[Text] The synthesization of DNA (the molecule that holds the information of the genetic characteristics of live organisms), until now possible only abroad, can now be done in Brazil. The Brazilian Biotechnology Company (EMBRABIO) is marketing a computerized apparatus, the DNA Synthesizer, that is capable of synthesizing molecules for the production of substances useful for humans and the detection at an early stage of viruses that cause infectious diseases. The apparatus will give new impetus to national science--genetic engineering already envisions the consolidation of its research and work with the possibility of synthesizing DNA in this country.

Launched in the United States in 1984 by the Applied Biosystems Company together with the University of California, the DNA Synthesizer was conceived with the aim of lending impetus to the activities of genetic engineering in the handling of DNA and the production of substances usable in medicine, such as, for example: insulins, hormones, and vaccines.

The EMBRABIO apparatus, still the only one in existence in Brazil, began operation last month and has already supplied basic products for molecular biology research, genetic engineering studies, and advanced medical diagnosis techniques. The first users of the apparatus were the Adolfo Lutz Institute, EMBRAPA, the Oswaldo Cruz Foundation, the School of Medicine and the Chemistry Institute of the University of Sao Paulo (USP). These institutions are scheduled to receive their own DNA Synthesizer by the end of the year at [a cost of] 650,000 cruzados.

In the opinion of Professor Hanza El-Dorry, of the USP Biochemistry Department, "the equipment represents a very important step for the development of national genetic engineering and biotechnology." He said also that "without the instrument we depend on the export [as published] of synthetic DNA, but now we will be able to synthesize DNA in our laboratories to make probes (DNA radioactively marked to be used in advanced diagnostic techniques) for the purpose of identifying genes that have biotechnological implication.

"With the equipment," continued El-Dorry, "Brazilian scientists will conduct their work in the biotechnological area and will be able to carry out various

projects that are ready to proceed." According to the professor, the intention is to market the instrument in the future to take care of the needs of all Latin America.

According to Venancio Alves, director of the pathology division of the Adolfo Lutz Institute, "in addition to being responsible for the epidemiological watch, the Adolfo Lutz Institute is interested in obtaining ever more specific and sensitive means for the rapid diagnosis of infectious diseases that can cause epidemics." In his opinion, "the apparatus will aid in this case and it is also a sure and precise method for the production of probes."

In order to operate the equipment, Dr Joao Renato Pinho of the Adolfo Lutz Institute is pursuing studies in molecular hybridization at the University of Lyons, in France. According to Alves, "the prediction is that the institute's apparatus will be operating by July of next year."

EMBRAPA, which has already used the DNA Synthesizer for the synthesization of a biological probe (the segment of the DNA complementary to a gene) for the purpose of detecting a gene or to locate the presence of viruses in plants, has been trying to raise funds to acquire the equipment.

Observing that it is "a sophisticated technological apparatus", Edgar Cunha Filho, an EMBRAPA researcher, said that the equipment will permit the detection at an early stage of infectious agents in plants and seedlings. "We will thus prevent the planter from using them in his planting," declared the researcher.

Production of DNA

The DNA Synthesizer is an apparatus with 64 kilobytes of memory, comprised of 18 receptacles where the reagents necessary for the production of a DNA are placed and connected to a system of valves controlled by the computer. Based on the DNA type keyed in by the operator, the computer controls seven valves, which remove the reagents from the flasks and effect the reaction in another receptacle in the apparatus.

At the end of the operation, which takes from 90 minutes to 45 hours depending on the type of DNA desired, the molecule will be ready in a small receptacle. After it is ready, the product is kept in a refrigerator at about 5 degrees Centigrade.

According to EMBRABIO's technical director, Roberto Waack: "Before the existence of the equipment, besides taking a minimum of 15 days to produce a DNA, the final cost was very high because of the great expense with reagents and the manpower necessary." A DNA produced by the apparatus costs from $100 to $1,500, depending on the type. "That price means a reduction of 50 percent in [the cost of] producing the molecules," said Waack.

8711/9835
CSO: 3699/30

DANISH BIOTECH FIRM MAY PRODUCE IN BRAZIL

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 2 Oct 86 p 3

[Text] The principal executives of the Danish Novo Industri Group--a pharmaceutical and biochemical multinational company that dominates the world market for industrial enzymes and that has had a distribution office in Brazil since 1970--were in Brazil to study the possibility of establishing a unit for the production of those catalyzing action proteins. The executives returned to Denmark "filled with optimism" about what they saw, confident that "there are good reasons" and that "perhaps it is the appropriate time" to invest in Brazil, but they have not decided anything concretely. The possibility of the domestic production of industrial enzymes continues to be merely a possibility, since the Novo Industri directors did not even set any time limits for the conclusion of their studies.

Among the difficulties mentioned regarding the establishment of a production unit in Brazil, the main reasons cited are of an economic nature. "The current Brazilian enzyme market does not justify the installation of an industry, which in this sector takes 5 years to begin to show a return," alleged Mads Ovlisen, the president of Novo Industri, pointing out that the group spent $25 million to install its fourth enzyme-producing unit, inaugurated in Japan last week. "Furthermore," he continued, "world production of enzymes is amply sufficient to meet demand."

The reasons given by the Danes to defer the project for the installation of a plant in Brazil were not only of an economic nature. "We have to wait for the 15 November election to see how the Brazilian politicians will treat foreign investment," added Ovlisen. "We also observed in talks with Brazilian businessmen that there is still great reluctance to use enzymes," added Erik Sorensen, the executive vice-president of Novo Industri. Paradoxically, despite all the "cons" pointed out, the Danes stated several times that the multinational should install an enzyme industry in Brazil.

Market

The world market for industrial enzymes (a product with wide application, used in the food, beverage, paper, and textile sectors, among several others)

is estimated at $425 million. Novo Industri, a conglomerate founded in 1925, has 50 percent of that market (the remainder is divided among 10 other producers). In Brazil, which imports almost all that it consumes--most of it from the Danish group--the industrial enzyme market is estimated at a little less than $10 million. The Novo Industri executives did not reveal how much revenue it derives from export sales to Brazil.

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